GigE Vision Area Scan Camera

Genie™ Monochrome Series

Camera User's Manual

M640

M1024

M1400

M1600

Preliminary

DALSA

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About DALSA
DALSA is an international high performance semiconductor and electronics company that designs, develops, manufactures, and markets digital imaging products and solutions, in addition to providing wafer foundry services.
DALSA Digital Imaging offers the widest range of machine vision components in the world. From industry-leading image sensors through powerful and sophisticated cameras, frame grabbers, vision processors and software to easy-to-use vision appliances and custom vision modules.
DALSA is a public company listed on the Toronto Stock Exchange under the symbol “DSA”.
Based in Waterloo, ON, Canada, the company has operations in Montreal, QC; Bromont, QC; Colorado Springs, CO; Eindhoven, NL; Munich, Germany and Tokyo, Japan.

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Introduction

Manual Overview

Camera Overview

- Describes the Genie series of cameras, their industry advantages, and the specifications for each monochrome area scan model.

Installation

- Covers GigE network adapters requirements, installation of the Genie camera and software framework, and verifying the installation with CamExpert.

Operational Reference

- Information on the Genie Sensor functions, camera trigger and exposure controls, exposure timing modes, external inputs and outputs, events, and Genie Processing.

Network Tools

- Information on using the Network Configuration utility to retrieve and change Genie default network parameters.

Sapera CamExpert Guide

- Overview on using Sapera CamExpert to control and configure the Genie camera.

Technical Specifications

- Covers Genie mechanical details, optical considerations, and sensor handling.

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Troubleshooting

- Information on installation or operational issues that may occur with Genie.

Support

- DALSA Contact Information
  Phone numbers, important web site links, and email addresses.

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About the Manual

This manual exists in compiled HTML help (CHM), and Adobe Acrobat® (PDF) formats. The help and PDF formats make full use of hypertext cross-references and include links to the DALSA home page on the Internet, located at http://www.imaging.com/, accessed using any web browser.

Using the Manual

File names, directories, Windows start menu selections, and Internet sites will be in bold text (e.g., **image2.bmp**, **c:\Sapera**, **http://www.imaging.com**).

Text that must be entered using the keyboard will be in typewriter-style text (e.g., `c:\temp`).

Menu and dialog actions will be indicated in bold text in the order of the instructions to be executed, with each instruction separated by bullets. For example, going to the **File** menu and choosing **Save** would be written as **File•Save**.

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Genie Monochrome Series Overview

Description

The Genie monochrome camera family form a series of affordable, easy to use digital cameras specifically engineered for industrial imaging applications. Genie cameras combine standard gigabit Ethernet technology with the DALSA Trigger-to-Image-Reliability framework to dependably capture and transfer images from the camera to the host PC.

All Genie cameras are supported by DALSA Sapera™ LT software libraries featuring CamExpert for simplified camera set-up and configuration. Sapera LT is field proven in thousands of robust industrial applications. Hardware independent, Sapera LT delivers the same reliable performance regardless of the image acquisition device being used. This unique feature allows OEM's to start using the Genie without re-writing applications developed for DALSA frame grabbers. In addition, Sapera LT includes powerful diagnostics and setup utilities for application development, custom camera configurations and system deployment.

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Genie Application Advantages

- Compact, rugged design
- GigE Vision 1.0 compliant
- Gigabit Ethernet (GigE) interconnection to a computer via standard CAT5e or CAT6 cables
- Connection to the host computer NIC through a GigE network switch
- Available in variety of resolutions
- Lookup table pre-processing
- Real-time shading correction (i.e. Flat Field processing)
- Supports several trigger modes for image capture control
- 2 opto-isolated inputs
- 2 opto-isolated outputs
- Native Trigger-to-Image Reliability design framework
- Visual status LEDs on camera back plate
- 1µs internal timer to timestamp images and events
- Supported by Sapera™ LT software libraries

Supported Network Configurations

The Genie obtains an IP address using the Link Local Address (LLA) or DHCP, by default. If required, a persistent IP address can be assigned (see "Running the Network Configuration Tool" on page 24).

The LLA method automatically assigns the Genie with a randomly chosen address on the 169.253.xxx.xxx subnet. After an address is chosen, the link-local process sends an ARP query with that IP onto the network to see if it is already in use. If there is no response, the IP is assigned to the device, otherwise another IP is selected, and the ARP is repeated. Note that LLA is unable to forward packets across routers.

Alternatively, if a DHCP server is present on the network, the Genie is going to issue a DHCP request asking for an IP address. The DHCP server will then provide the Genie an IP address.

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Product Part Numbers

This manual covers the five monochrome Genie models summarized below. See "Camera Performance Specifications" on page 8 for each Genie model.

Camera	Sensor Size	Resolution	Pixel size (µm)	fps (full frame)	Product Number
Genie M640-1/2	1/2 in	640 x 480	9.9 x 9.9	60	CA-GEN0-AM64G
Genie M640-1/3	1/3 in	640 x 480	7.4 x 7.4	60	CA-GEN3-AM64G
Genie M1024	1/3 in	1024 x 768	4.65 x 4.65	20	CA-GEN0-AM10G
Genie M1400	1/2 in	1360 x 1024	4.65 x 4.65	15	CA-GEN0-AM12G
Genie M1600	1/1.8 in	1600 x 1200	4.40 x 4.40	12	CA-GEN0-AM16G

Software	Product Number
Sapera runtime & Genie software components (Genie server, Sapera network imaging driver)	Included with Genie and installed automatically
GenICam™ support (XML camera description file)	Embedded within Genie
Sapera LT version 6.00 or later (sold separately): Provides everything you will need to develop imaging applications Sapera documentation in compiled HTML help, and Adobe Acrobat® (PDF) formats	OC-SL00-0000000
Sapera Processing Imaging Development Library (sold separately): Includes over 600 optimized image processing routines.	Contact Sales at DALSA

Genie Cables & Accessories (sold separately)	Product number
Genie I/O and Power breakout cable (Hirose to Euroconnector)	CA-GENC-IOP00
Tripod mount bracket (mount to Genie top or bottom—provides ¼-20 socket)	CA-GENA-BRA00
12VDC power supply (with blunt end cable)	CA-GENA-PS120
Industrial type CAT 6 cable assembly: Molded shroud with top/bottom thumbscrews on one end with standard Ethernet RJ45 clip on other. Available in various lengths. See "Industrial RJ45 Ethernet Cables" on page 99.	

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Camera Performance Specifications

Specifications for each available sensor are listed after the general Genie camera specifications.

Camera Controls	
Synchronization Modes	Free running and Triggered Synchronous and Reset mode Software trigger (through Ethernet)
Exposure Modes	Programmable (1µs granularity) Pulse controlled
Trigger Input	Opto-isolated, 2V to 12V typical, 2mA min. Debounce range from 1 µs up to 255 µs
Strobe Output	Output opto-isolated: Aligned to the start of exposure with a programmable delay, duration and polarity
Features	
LUT	8-bit
Binning	Horizontal (2 pixel) and Vertical (2 line)
Timestamp	1µs internal timer to timestamp images and events
Test image	Internal pattern generator
User settings	Select factory default or one user camera configuration
Optical Interface	
Back Focal Distance—C mount	17.52 mm
Mechanical Interface	
Camera Size	29(H) x 44(W) x 67(L) in mm, (see Mechanical Specifications)
Mass	< 125g (no lens)
Power connector	12 pin male Hirose
Ethernet connector	RJ45
Electrical Interface	
Input Voltage	+11 to +13 Volts DC, (over voltage–reverse voltage protected)
Power Dissipation	< 4W
Operating Temperature	0 to 45°C
Output Data Configuration	Gigabit Ethernet (IEEE 802.3)
Data and Control	GigE Vision compliant at 1000 or 100 Mbps
Certifications	FCC class A, CE (pending)

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Supported Industry Standards

Genie cameras are 100% compliant with the GigE Vision 1.0 specification which defines the communication interface protocol used by any GigE Vision device. For more information see: http://www.machinevisiononline.org/public/articles/index.cfm?cat=167

Genie cameras implement a superset of the GenICam™ specification which defines device capabilities. This description takes the form of an XML device description file respecting the syntax defined by the GenApi module of the GenICam™ specification. For more information see www.genicam.org.

Genie Sensor Overview

Each sensor description below provides a specification table and response graphic. The graph describes the sensor response to different wavelengths of light (excluding lens and light source characteristics). Visible light spans wavelengths between about 390 - 780 nanometers. Wavelengths below 390 nm is termed ultra-violet while those above 780 nm. is termed infra-red. The peak response is around 500 nanometers, corresponding to a shade of blue-green.

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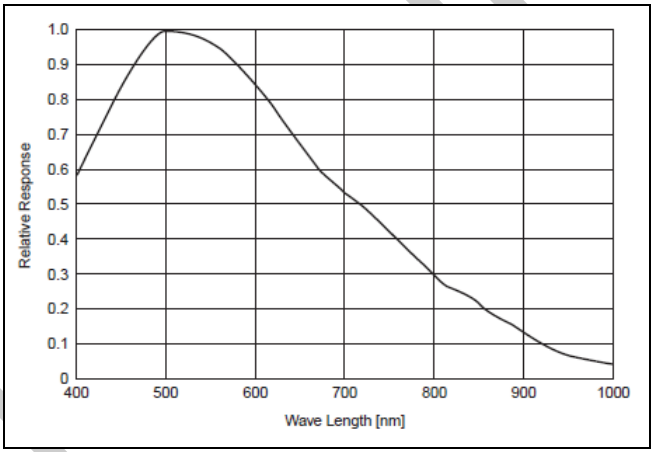
Genie M640-1/2 Specifications

Item / Feature	Specification
Imager Format	Full frame interline CCD area scan with square pixel
Sensor	Sony ICX414AL
Resolution	640 x 480 pixels
Minimum Frame Rate (free-running)	0.1 fps (one frame every 10 seconds)
Maximum Frame Rate (free-running)	60 fps
Maximum Exposure	1 / frame rate - 100µs
Pixel Size	9.9µm x 9.9µm
Pixel Format	8-bit
Shutter	Full frame electronic shutter
Gain Range	-6dB to +12dB

Genie M640-1/2 Responsivity



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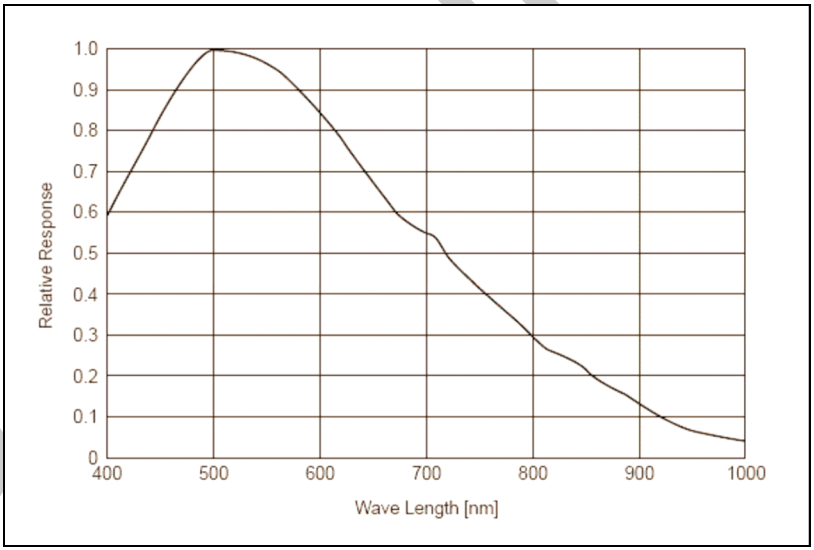
Genie M640-1/3 Specifications

Item / Feature	Specification
Imager Format	Full frame interline CCD area scan with square pixel
Sensor	Sony ICX424AL
Resolution	640 x 480 pixels
Minimum Frame Rate (free-running)	0.1 fps (one frame every 10 seconds)
Maximum Frame Rate (free-running)	60 fps
Maximum Exposure	1 / frame rate - 100µs
Pixel Size	7.4µm x 7.4µm
Pixel Format	8-bit
Shutter	Full frame electronic shutter
Gain Range	-6dB to +12dB

Genie M640-1/3 Responsivity



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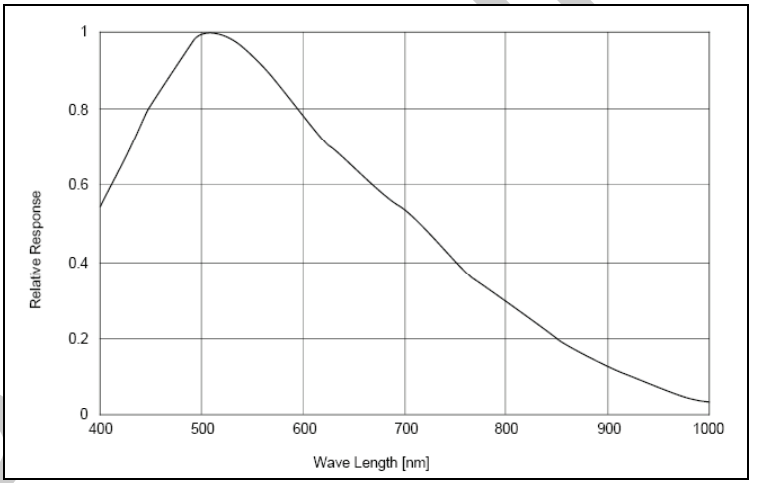
Genie M1024 Specifications

Item / Feature	Specification
Imager Format	Full frame interline CCD area scan with square pixel
Sensor	Sony ICX204AL
Resolution	1024 x 768 pixels
Minimum Frame Rate (free-running)	0.1 fps (one frame every 10 seconds)
Maximum Frame Rate (free-running)	20 fps
Maximum Exposure	1 / frame rate - 100µs
Pixel Size	4.65µm (H) × 4.65µm (V)
Pixel Format	8-bit
Shutter	Full frame electronic shutter
Gain Range	-6dB to +12dB

Genie M1024 Responsivity



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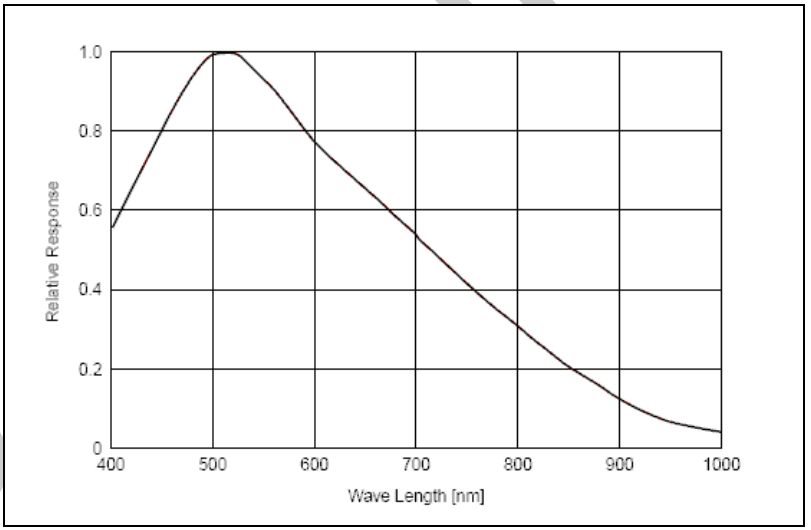
Genie M1400 Specifications

Item / Feature	Specification
Imager Format	Full frame interline CCD area scan with square pixel
Sensor	ICX267AL
Resolution	1360 x 1024 pixels
Minimum Frame Rate (free-running)	0.1 fps (one frame every 10 seconds)
Maximum Frame Rate (free-running)	15 fps
Maximum Exposure	1 / frame rate - 100µs
Pixel Size	4.65µm (H) x 4.65µm (V)
Pixel Format	8-bit
Shutter	Full frame electronic shutter
Gain Range	-6dB to +12dB

Genie M1400 Responsivity



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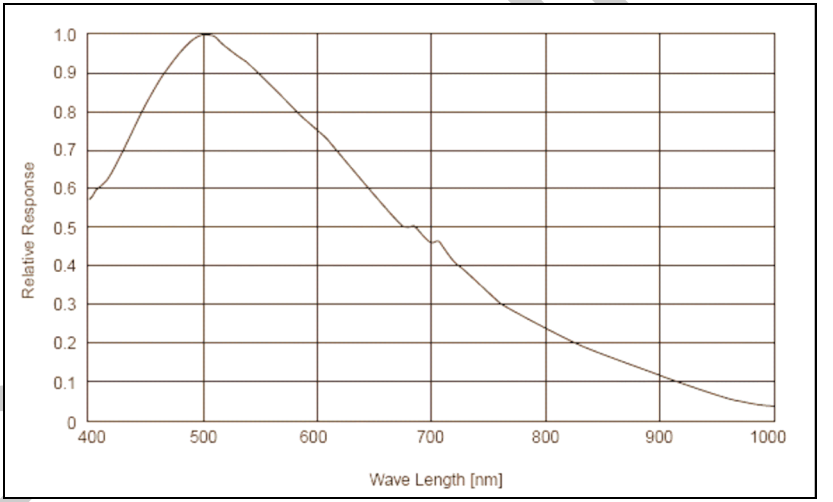
Genie M1600 Specifications

Item / Feature	Specification
Imager Format	Full frame interline CCD area scan with square pixel
Sensor	Sony ICX274AL
Resolution	1600 x 1200 pixels
Minimum Frame Rate (free-running)	0.1 fps (one frame every 10 seconds)
Maximum Frame Rate (free-running)	12 fps
Maximum Exposure	1 / frame rate - 100µs
Pixel Size	4.40µm (H) × 4.40µm (V)
Pixel Format	8-bit
Shutter	Full frame electronic shutter
Gain Range	-6dB to +12dB

Genie M1600 Responsivity



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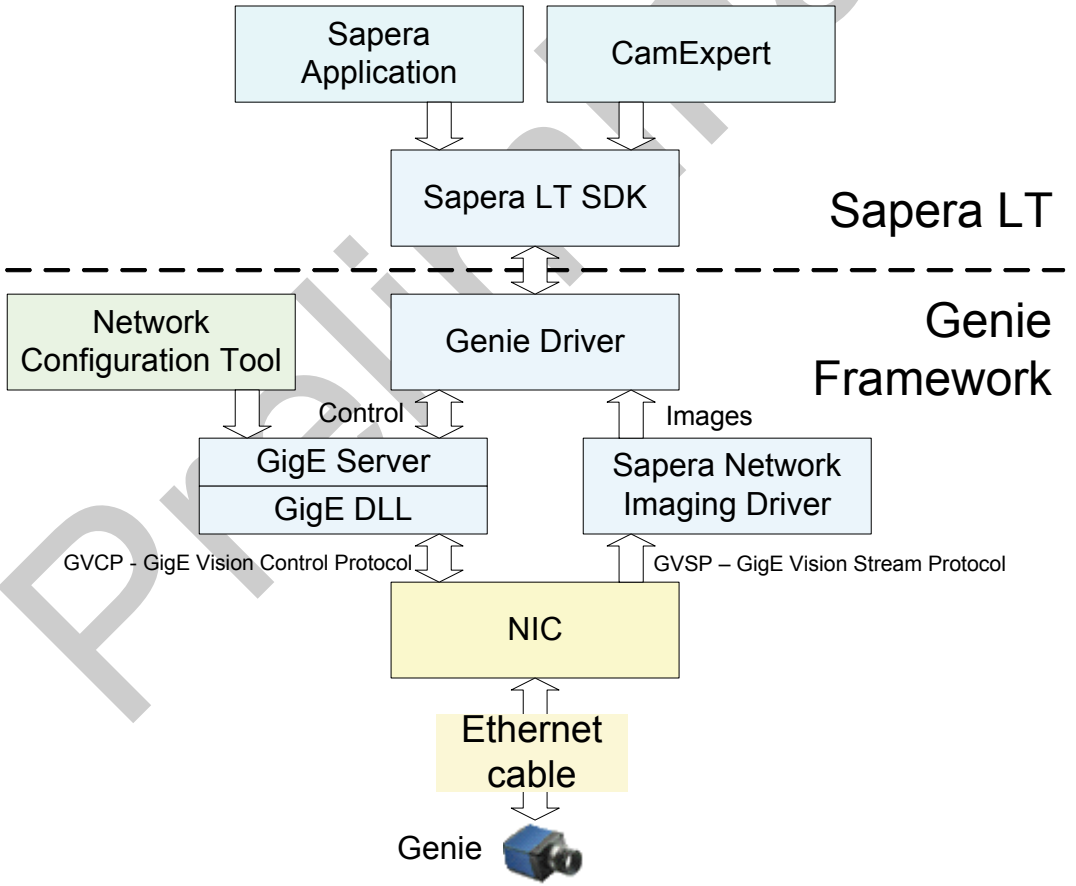
Application Development Overview

Sapera LT Library with optional Processing

Sapera LT is a powerful development library for image acquisition and control. Sapera LT provides a single API across current and future DALSA hardware. Sapera LT delivers a comprehensive feature set including program portability, versatile camera controls, flexible display functionality and management, plus easy to use application development wizards.

Sapera Processing is a comprehensive set of C++ classes for image processing and analysis. Sapera Processing offers highly optimized tools for image processing, blob analysis, search (pattern recognition), OCR and barcode decoding.

The following is a Sapera application functional block diagram.



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GenICam Environment

Genie cameras implement the GenICam™ specification which define the device capabilities. The GenICam XML device description file is embedded within Genie firmware allowing GenICam applications to know Genie capabilities immediately after connection. For more information about the GenApi module of the GenICam™ specification see www.genicam.org.

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Installing the Genie Camera

Warning! (Grounding Instructions)

Static electricity can damage electronic components. Please discharge any static electrical charge by touching a grounded surface, such as the metal computer chassis, before performing any hardware installation.

If you do not feel comfortable performing the installation, please consult a qualified technician.

GigE Network Adapter Guideline

If the computer to be used with the Genie camera does not have a Gigabit network adapter or second built in Gigabit NIC, a PCI bus Gigabit NIC needs to be installed. Typically under Windows XP the PCI Gigabit NIC is recognized automatically when Windows boots. An example of a high performance NIC is the Intel PRO/1000 MT adapter.

Review the NIC documentation concerning any special driver required for Windows 2000 or Windows XP. Install the PCI bus Gigabit NIC as described by the NIC manufacture's documentation.

The Genie camera has been tested with a variety of Gigabit network adapters, both built into the system motherboard and as third party PCI adapters.

Using Genie with Ethernet Switches

Examples where a Gigabit Ethernet switch would be used are:

- Multiple Genie cameras are controlled by one computer and a single NIC (running multiple instances of CamExpert as an example of the control program).
- Multiple Genie cameras are individually controlled by multiple computers, all located on the same subnet.

In these cases the Ethernet switch is a transparent device. The device discovery process finds all Genie cameras, and presents them as ready to be controlled by an application such as CamExpert.

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Using Genie with a VLAN Ethernet Switch

An Ethernet switch supporting VLAN (Virtual Local Area Network) allows multiple isolated subnets to exist on the same switch.

Within each VLAN group, the Genie camera and controlling computer will behave identically as if connected to a simple Ethernet switch. But each VLAN group is isolated from each other, Therefore a Genie in one VLAN group is never seen by a computer on a different VLAN group.

VLAN Ethernet Switches support configuration as Port-based or TAG VLAN groups. Port-based groups are typically easier to configure. Review your Ethernet switch manual for information on its factory default VLAN settings and configuration method.

Installation Overview & Preparations

The Genie camera installation generally follows the sequence described below. Detailed installation instructions follow this overview.

Network and Computer Overview

- Genie needs to connect to a computer with a **GigE network adapter**, either built in on the computer motherboard or installed as a third party PCI adapter.
- Genie also can connect through a **Gigabit Ethernet switch**. When using VLAN groups, the Genie and controlling computer must be in the same group (see "Using Genie with a VLAN Ethernet Switch" on page 18).
- If Genie is to be used in a **Sapera development environment**, Sapera LT needs to be installed, either before or after the Genie software package. If Genie will be used in a GenICam™ environment, Sapera is not required and you need to follow the installation instructions of the third party GenICam compliant package.
- Install the **Genie software package** if not using a third party GenICam compliant package. The Genie package includes Sapera Run-time with CamExpert to control and program the Genie, plus the network imaging driver to manage the interface to Genie.
- The **Windows Firewall** exceptions feature is automatically configured to allow the Sapera GigE Server to pass through the firewall.
- The **Sapera CamExpert** tool (automatically installed with Genie software) can be used to control the Genie even if Sapera development is not required.

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Installation Overview

- Inspect all cables and connectors prior to their use. Do not use faulty cables or connectors to avoid camera damage.
- Before connecting power to the camera, test all power supplies. Power supplies must meet the requirements defined in section "Genie Signal Electrical Details" on page 92. Apply power to the camera.
- Connect Genie to the computer GigE network adapter or to the Ethernet switch via a CAT5e or CAT6 Ethernet cable.
- Check the diagnostic LED which will be initially red then switch to flashing blue while waiting for IP configuration. See "Status LED Codes" on page 22 for Genie LED display descriptions.
- Look at the small camera icon added to the Windows tray (next to the clock). Ensure the Genie camera has been found.
- A new Genie installation typically requires a firmware update. See the procedure "Updating Genie Firmware" on page 25.
- Use CamExpert (installed either with Sapera or the Genie software package) to test the installation of the Genie camera. Set the Genie to internal test pattern. See "Sapera CamExpert Guide" on page 85.
- Set up the other components of the imaging system such as light sources, camera mounts, optics, encoders, trigger sources, etc. Test with CamExpert.

Sapera LT Library Installation

Note: to install Sapera LT and the Genie device driver, logon to the workstation as an administrator or with an account that has administrator privileges.

When Sapera application development is performed on the same computer that the Genie is connected to, the Sapera Development Library (version 6.0 or later) must be installed. Else, Sapera LT is not required to control the Genie camera.

- Insert the DALSA Sapera CD-ROM. If **AUTORUN** is enabled on your computer, the DALSA installation menu is presented.
- If **AUTORUN** is not enabled, use Windows Explorer and browse to the root directory of the CD-ROM. Execute **launch.exe** to start the DALSA installation menu and install the required Sapera components.
- The installation program will prompt you to reboot the computer.
- Continue with the Genie Software Package Installation described next.

Refer to *Sapera LT User's Manual* concerning application development with Sapera.

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Genie Software Package Installation

The Genie software package installation provides all components required (Sapera run-time) to control the Genie with the supplied CamExpert tool. Genie software components include the Network Imaging driver, the Sapera GigE server, and CamExpert (if Sapera LT library is not installed).

If Sapera application development is required, install Sapera (6.0 or later) as described in the previous section.

Procedure

- Insert the DALSA Genie CD-ROM. If **AUTORUN** is enabled on your computer, the Genie installation menu is presented.
- If **AUTORUN** is not enabled, use Windows Explorer and browse to the root directory of the CD-ROM. Execute **launch.exe** to start the installation menu and install the Genie software components.
- Click to install the Genie Software Framework which includes the Network Imaging driver, and the Sapera GigE server.
- The procedure will prompt for acceptance of the installation folder for the Genie files.
- If desired, click to install **Sapera LT run-time** which includes CamExpert. Follow the on screen prompts and reboot when the installation is complete.

GigE Server Verification

After a successful Genie software package installation, the GigE Server icon is visible in the desktop taskbar tray area. The Genie camera must be on the same subnet as the NIC to be recognized by the GigE Server. With no Genie connected the icon has a red X through it.

If you place your mouse cursor on this icon, the GigE Server will display the number of GigE Vision devices found by your PC. Left clicking on this icon will provide you with options about the status of those devices. See "Running the Network Configuration Tool" on page 24 for more information.

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Connect the Genie Camera

Connect a power supply to the Genie camera and an Ethernet cable from the Genie to the host computer. See the next section "Connectors" on page 21 for an overview of the Genie interfaces. Once communication with the host computer is started the automatic IP configuration sequence will assign an LLA IP address as described in section "Genie IP Configuration Sequence" on page 23, or a DHCP IP address if a DHCP server is present on your network. The factory defaults for Genie is Persistent IP disabled and DHCP enabled with LLA always enabled as per the GigE Vision specification. For additional information see "IP Configuration Mode Details" on page 75.

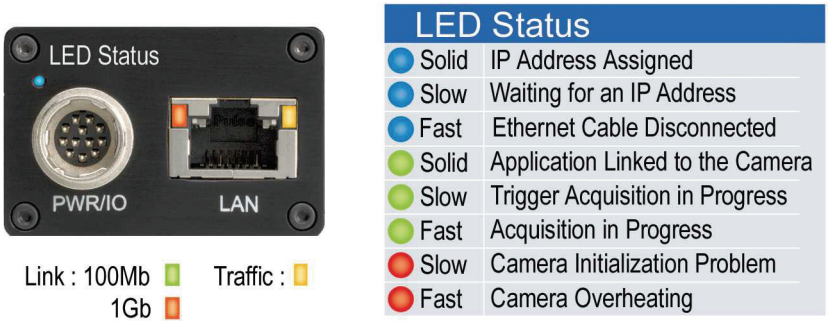
Connectors

The Genie has only two connectors:

- A single **RJ45 Ethernet** connector for control and video data transmitted to/from the host computer Gigabit NIC. See "Industrial RJ45 Ethernet Cables" on page 99 for secure cables.
- A single **12-pin Hirose** male connector for camera power plus trigger, strobe and general I/O signals. The suggested female cable mating connector is Hirose model HR10A-10P-12S.

The Genie has one multicolor LED to provide a simple visible indication of camera state (see figure below and section "Status LED Codes" on page 22). Additionally the RJ45 has two LEDs for network status conditions.

The following figure of the Genie back end shows connector and LED locations. See "Mechanical Specifications" on page 89 for details on the Genie connectors and camera mounting dimensions.



Genie – Rear View

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Status LED Codes

The camera is equipped with a LED to display the operational status of the camera. When more than one condition is active, the LED color indicates the condition with the highest priority (such as an acquisition in progress has more priority than a valid IP address assignment). The following table summarizes the LED states and corresponding camera status.

LED State	Definition
LED is off	No power to the camera
Steady Red	Camera not initialized
Slow Flashing Red	Camera initialization problem
Fast Flashing Red	Camera is too hot
Slow Flashing Blue	Waiting for an IP address
Fast Flashing Blue	Ethernet cable disconnected (no link)
Steady Blue	IP address assigned; no application connected to the camera
Steady Green	Application connected
Slow Flashing Green	Triggered acquisition in progress
Fast Flashing Green	Free-running acquisition in progress

Once the Genie has its RJ45 connected to a network, the Status LED will turn to steady blue when the IP address is correctly assigned. Only at this time will it be possible by the GigE Server or any application to communicate with the camera.

Note that even if the Genie has obtained an IP address, it might be on a different subnet than the NIC it is attached to. Therefore, if the Genie LED is blue but an application such as CamExpert can not see it, this indicates a network configuration problem.

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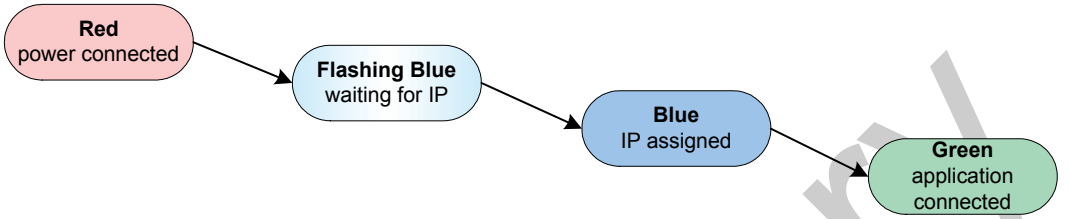
Typical LED States on Power Up

The following LED sequence occurs when the Genie is powered up connected to a network with installed Genie Framework software.



Genie IP Configuration Sequence

The Genie IP (Internet Protocol) Configuration sequence to assign an IP address is executed automatically on camera power-up or when connected to a network. As a GigE Vision compliant device, Genie attempts to assign an IP address as follows.

For any GigE Vision device, the IP configuration protocol sequence is:

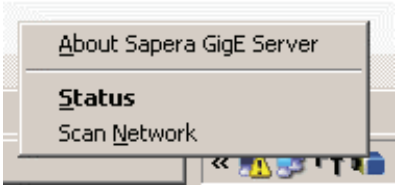
- Persistent IP (if enabled)
- DHCP (if enabled)
- Link-Local Address (always enabled)

The factory defaults for Genie is Persistent IP disabled and DHCP enabled with LLA always enabled as per the GigE Vision specification. For additional information see "IP Configuration Mode Details" on page 75.

GigE Server Status

Once the Genie is assigned an IP address (its Status LED is steady blue) the GigE server tray icon will not have a red X through it, indicating that the Genie device was found. It might take a few seconds for the GigE Server to refresh its state after the Genie has obtained an IP address.

Right-click the GigE Server tray icon to open the following menu.



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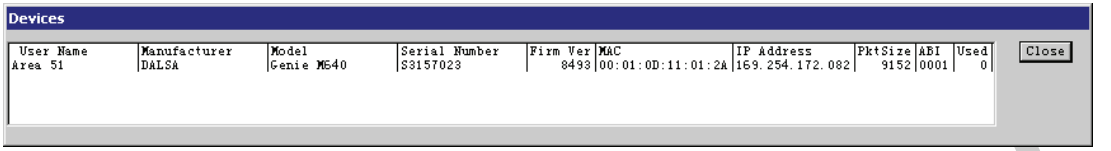
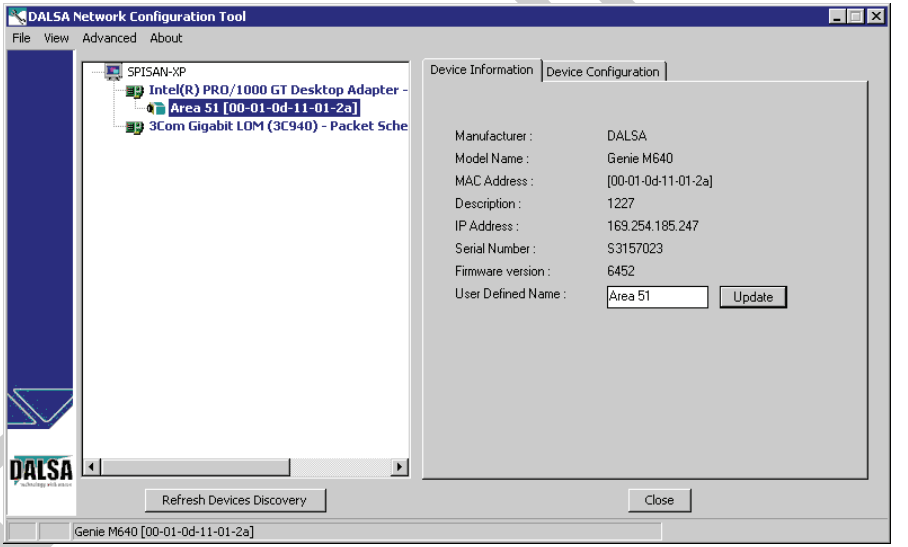
Click on **Status** to open a window listing all devices connected to the host system. Each GigE device is listed by name along with important information such as the assigned IP address and device MAC address.



In the event that the device is physically connected, but the Sapera GigE Server icon is indicating that the connected device is not recognized, click **Scan Network** to restart the discovery process. Note that the GigE server periodically scans the network automatically to refresh its state.

Running the Network Configuration Tool

Once the GigE Server discovers a device, start the Network Configuration tool to verify and modify the network configuration of the imaging system. See "Network Configuration Tool" on page 77.



First verify the Genie camera appears as a child of the NIC card it is connected to. By default the Genie camera is identified by its serial number if no user-defined name has been assigned.

Because image transfers require considerable bandwidth through the NIC, it is recommended that a separate Gigabit Ethernet NIC for the Genie camera be used. Connections to the Internet or to a corporate network should be through a different NIC.

The Network Configuration Tools allows you to:

- Configure the Windows firewall exception list

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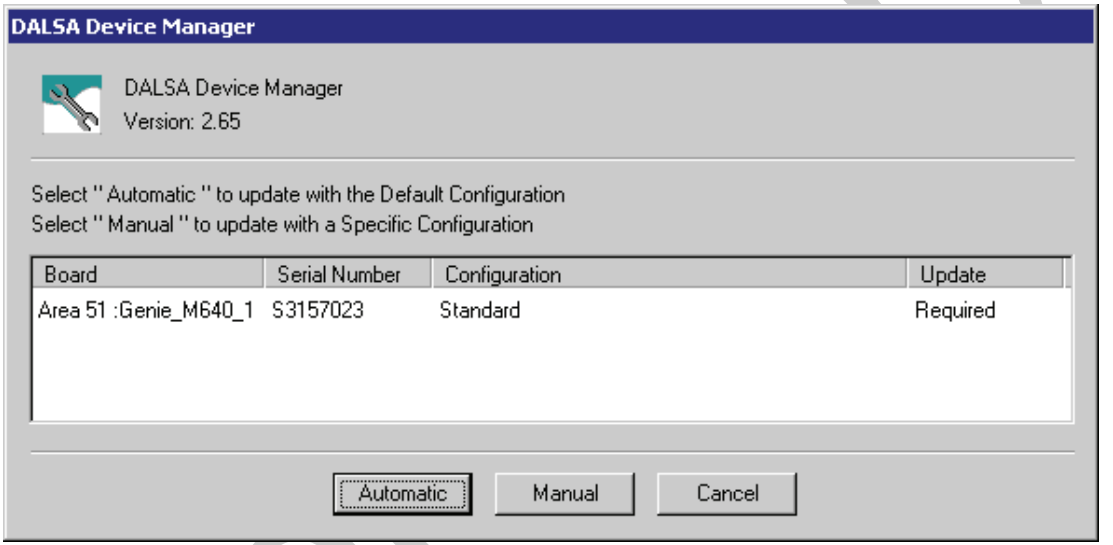
- Activate the Network Imaging driver use for image acquisition on any NIC
- Configure the NIC and camera IP settings

Updating Genie Firmware

The Genie firmware may need to be updated to correspond with the currently used Genie software framework. After installing the new Genie software package and Genie camera, update the firmware by following this procedure.

- Start the DALSA Device Manager program from the windows start menu: **Start•Programs•DALSA•Genie•Firmware Update**.



- The right hand column shows whether a firmware update is **Required** or **Not Required**.
- If an update is required, click on the Automatic button. The Update Firmware manager dialog opens and the new firmware version is written to the Genie camera.
- The manual button allows the user to select from multiple Genie firmware configuration files – if such files become available for future operational modes.

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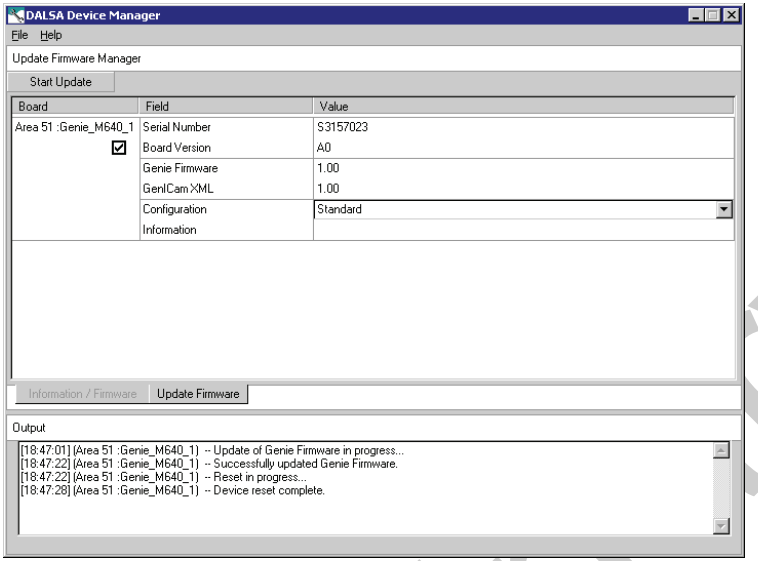

- The update is complete when the lower message output area says "Device reset complete".
- Close the Device Manager program.
- **Important:** Before running any Genie control program, cycle the power supply on the Genie.
- Wait for the GigE Server to find the Genie again, then run CamExpert to test the Genie operation (as described below).

Quick Test with CamExpert

When the Genie camera is directly connected to a Gigabit network adapter on a host computer or via a network switch, testing the installation with CamExpert is a straightforward procedure.

- Start Sapera CamExpert by double clicking the desktop icon created during the Genie software installation.
- CamExpert will search for installed Sapera devices. In the Device list area on the left side, the connected Genie camera is shown or will be listed in a few seconds after CamExpert completes the automatic device search (device discovery).
- Select the Genie camera device by clicking on the camera user-defined name. By default the Genie camera is identified by its serial number. The LED of the Genie will turn green, indicating the CamExpert application is now connected.
- Click on the Grab button for live acquisition (the Genie default is Free Running mode). Focus and adjust the lens iris. See "Operational Reference" on page 29 for information on CamExpert parameters with the Genie camera.
- The following figure shows CamExpert with the Genie generating a diagonal test pattern.

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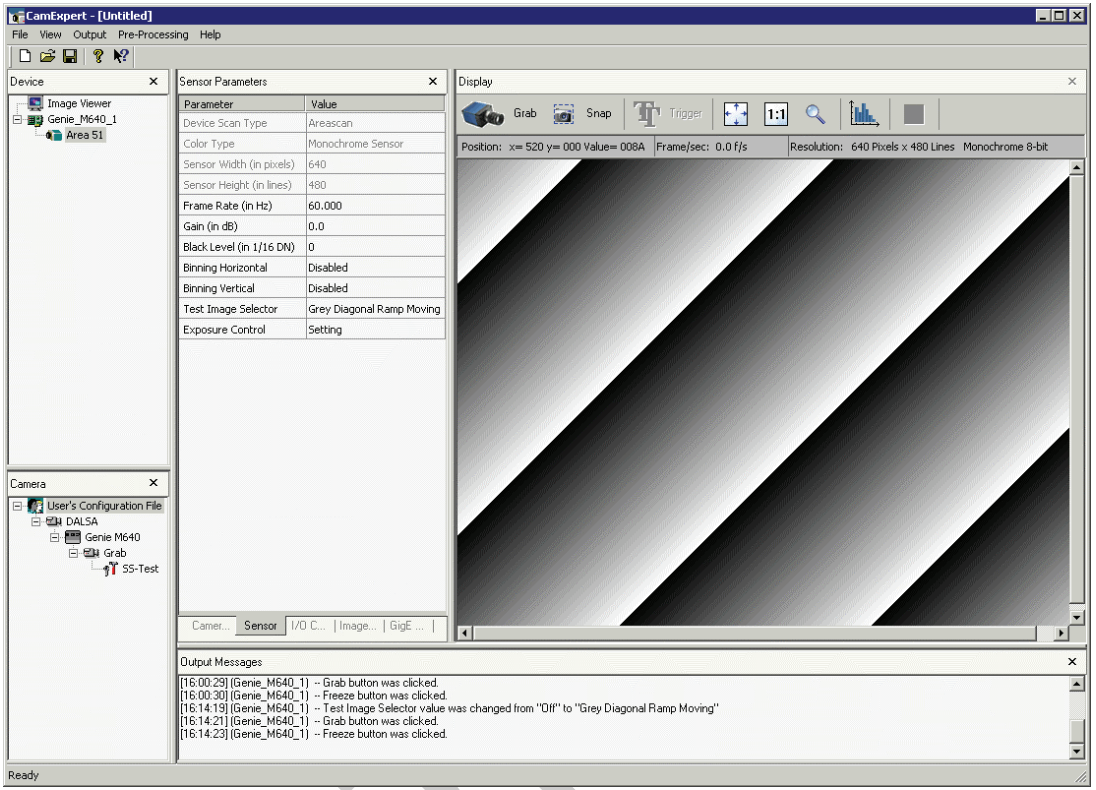
CamExpert - [Untitled]
File View Output Pre-Processing Help
Device
Image Viewer
Genie_M640_1
Area 51
Sensor Parameters
Parameter Value
Device Scan Type Areascan
Color Type Monochrome Sensor
Sensor Width (in pixels) 640
Sensor Height (in lines) 480
Frame Rate (in Hz) 60.000
Gain (in dB) 0.0
Black Level (in 1/16 DN) 0
Binning Horizontal Disabled
Binning Vertical Disabled
Test Image Selector Grey Diagonal Ramp Moving
Exposure Control Setting
Camer... Sensor I/O C... Image... GigE ...
Display
Grab Snap Trigger 1:1
Position: x= 520 y= 000 Value= 008A
Frame/sec: 0.0 f/s
Resolution: 640 Pixels x 480 Lines Monochrome 8-bit
Camera
User's Configuration File
DALSA
Genie M640
Grab
SS-Test
Output Messages
[16:00:29] (Genie_M640_1) -- Grab button was clicked.
[16:00:30] (Genie_M640_1) -- Freeze button was clicked.
[16:14:19] (Genie_M640_1) -- Test Image Selector value was changed from "Off" to "Grey Diagonal Ramp Moving"
[16:14:21] (Genie_M640_1) -- Grab button was clicked.
[16:14:23] (Genie_M640_1) -- Freeze button was clicked.
Ready

Preli

About the User-Defined Camera Name

The Genie can be programmed with a user-defined name to aid identifying multiple cameras connected to the network. For instance, on an inspection system with 4 cameras, the first camera might be labeled “top view”, the second “left view”, the third “right view” and the last one “bottom view”. The factory default user name is set to match the camera serial number. Note that the factory programmed Genie serial number and MAC address is not user changeable.

When using CamExpert, multiple Genie cameras on the network are seen as different "Genie_M640_x" devices. Click on a Genie device user name to select it for control by CamExpert. Each time you start a Sapera LT application, the camera associated to a given “Genie_M640_x” instance might change since this is dependent on the sequence in which cameras answer the device discovery request.

An imaging application uses any one of these attributes to identify a camera: its IP address, MAC address, serial number or User Name. Some important considerations are listed below.

- Do not use the camera's IP address as identification (unless it is a persistent IP) since it can change with each power cycle.
- A MAC address is unique to a single camera, therefore the control application is limited to the vision system with that unique camera.
- The User Name can be freely programmed to clearly represent the camera usage. This scheme is recommended for an application to identify cameras. In this case, the vision system can be duplicated any number of times with cameras identified by their function, not their serial numbers.

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Operational Reference

Camera and Sensor Information

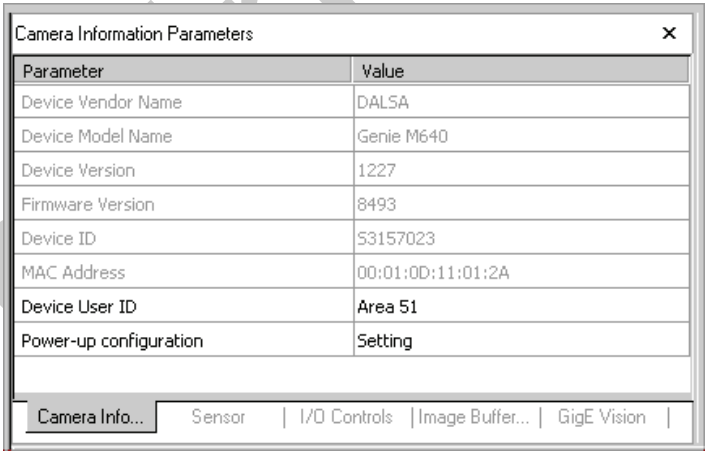
Camera and sensor information can be retrieved via a controlling application. Parameters such as camera model, firmware version, sensor characteristics, etc. are read to uniquely identify the connected Genie device.

All these features, with the exception of the DeviceUserId, are read-only. Sapera LT or GenICam calls can be used to retrieve this information and correctly identify the camera along with its characteristics.

Following is an overview of CamExpert displaying this information followed by tables with the feature name associated to Sapera LT and to GenICam development environments.

Access Via CamExpert

The Camera Information Parameters tab groups parameters that contain information specific to the individual Genie camera.



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Read Only Parameters

Parameter	Description
Device Vendor	For the Genie Monochrome series, this is always DALSA.
Device Model Name	Displays the device model name (for example, Genie M640).
Device Version	Displays the device version.
Firmware Version	Displays the currently loaded firmware version.
Device ID	Displays the camera serial number.
MAC Address	Displays the unique MAC (Media Access Control) address of the Genie camera.

User Set Parameters

Parameter	Description
Device User ID	Specifies a user ID, of up to 15 characters, for the Genie camera. By default, this field is set to the serial number of the camera.
Power-up Configuration	Click **Setting** to open the **Power-up configuration** dialog box which allows you to specify camera power-up configuration. For more information, see "Power-up Configuration" on page 30.

Power-up Configuration

The **Power-up configuration** dialog allows you to specify the camera configuration to load when powering-up the camera. The Genie camera flash memory contains two possible configuration settings; the Factory Default, and a user-defined Camera Configuration 1. The **Camera Power-up configuration** drop-down list box allows you to select either the Factory Default or a user specified camera configuration file. To save the current CamExpert settings to the camera user-defined (Camera Configuration) setting, click **Save**. To view in CamExpert a camera configuration file currently saved in the camera, select the configuration file in the **Load configuration from Camera** drop-down list, and click **Load**. See "Genie Power-up Configuration" on page 66 for a list of the saved parameters.

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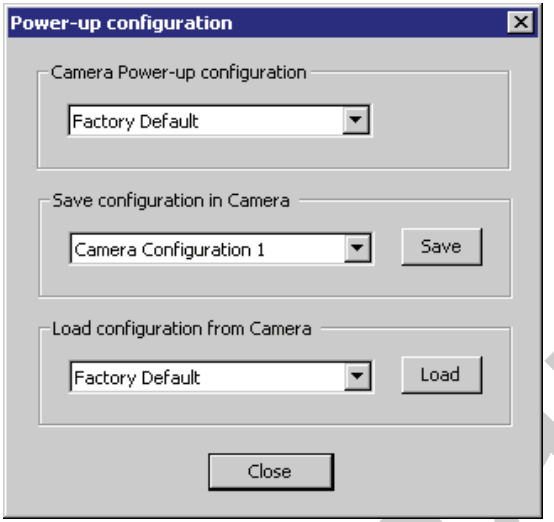

Camera Information via Sapera LT or GenICam Applications

Sapera	Genie Sapera parameters for Camera and Sensor Information: **Interface** = {GigE Vision = 0} **DeviceVendorName** = "DALSA" **DeviceModelName** = "Genie M640" for Genie M640 **DeviceVersion** = String representing the version of the camera **FirmwareVersion** = String representing the version of the camera firmware **DeviceID** = String representing the camera serial number **MACAddress** = String representing the camera MAC address **DeviceUserID** = String representing the user-define name for the camera **DeviceMaxThroughput** = Maximum throughput of image streaming in bytes/sec. **DeviceScanType** = {Areascan = 0} **ColorType** = {Monochrome Sensor = 0} **SensorWidth** = Width of the sensor in pixels **SensorHeight** = Height of the sensor in lines **PixelSize** = Number of bits per pixel In CamExpert, these parameters are visible under "Camera Information" and "Sensor" tabs.

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GEN<i>CAM	GenICam features for Camera and Sensor Information: **DeviceVendorName** = Name of camera vendor **DeviceModelName** = Name of the camera model **DeviceManufacturerInfo** = Additional information about this camera **DeviceVersion** = Version of the device **DeviceFirmwareVersion** = Version of camera firmware **DeviceID** = Serial number of the camera **DeviceUserID** = User-defined name the camera **DeviceScanType** = {Areascan = 0} **DeviceMaxThroughput** = Maximum number of bytes per second device supports **DeviceRegistersStreamingStart** = Announces the start of registers streaming without immediate checking for consistency **DeviceRegistersStreamingEnd** = Announces the end of registers streaming and perform validation for registers consistency before activating them **DeviceRegistersCheck** = Performs an explicit register set validation for consistency **DeviceRegistersValid** = Informs whether the current register set is valid and consistent **SensorWidth** = Width of sensor (effective pixels) **SensorHeight** = Height of sensor (effective pixels) **WidthMax** = Maximum image width. Depends on binning and decimation **HeightMax** = Maximum image height. Depends on binning and decimation

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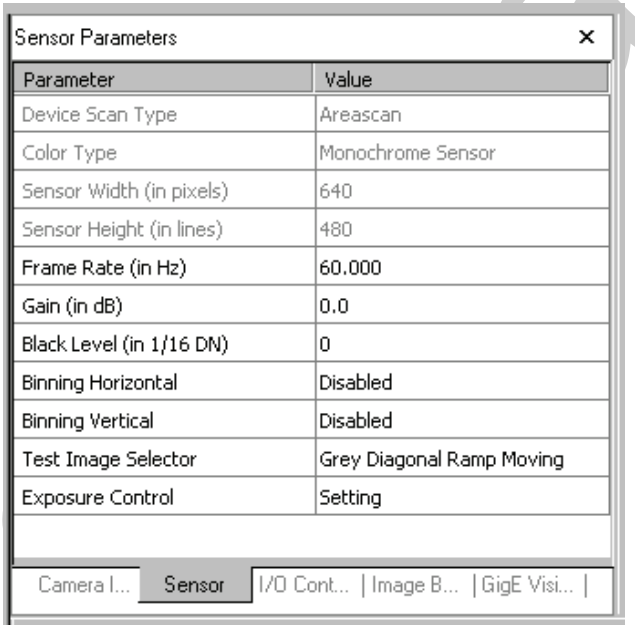
Sensor Controls

Genie provides a number of sensor controls to optimize image acquisitions for most imaging solutions. Following is an overview of the CamExpert controls displaying this information, followed by individual control function descriptions and tables indicating the feature name associated to Sapera LT and to GenICam development environments.

Sensor Parameters: Controls Via CamExpert

The Sensor Parameters tab groups the parameters related to the camera sensor configuration for acquisition.



Read Only Parameters

Parameter	Description
Device Scan Type	Displays the device scan type. Possible values are area scan or linescan. This is always area scan for Genie.
Color Type	Displays the color type of the sensor. Possible values are Color Sensor or Monochrome Sensor.
Sensor Width (in pixels)	Displays the sensor width (in pixels).
Sensor Height (in pixels)	Displays the sensor height (in pixels).

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User Set Parameters

Parameter	Description
Frame Rate (in Hz)	Specifies the internal trigger frame rate for free run mode, in Hz. Possible values range from 0.1 to 60.0 Hz for Genie M640 in full scan mode. (Note: the Sapera SDK specifies the frame rate in milliHertz). The maximum frame rate increases by using binning (see below) or partial scan (see "Partial Scan—Window ROI" on page 36).
Gain (in dB)	Specifies the sensor analog Gain factor, in dB. Possible values range from –6.0 to 12.0 dB, in 0.1 dB increments. For more information, see "Gain and Black Level Controls" on page 35.
Black level (in 1/16 DN)	Specifies the sensor black level, in 1/16 DN (digital number, which is the value assigned to a pixel in a digital image). Possible values range from -128 to 127.
Binning Horizontal	Enables or disables horizontal binning. Possible values are Disabled or 2 pixels. When set to 2 pixels, the image buffer width parameter is automatically adjusted. For more information, see "Binning" on page 40.
Binning Vertical	Enables or disables the vertical binning. Possible values are Disabled or 2 lines. When set to 2 lines, the image buffer height parameter is automatically adjusted. The maximum frame rate also increases.
Test Image Selector	Specifies the test image. Possible values are: Off Grey Horizontal Ramp Grey Vertical Ramp Grey Diagonal Ramp Moving Purity For more information, see "Internal Image Test Patterns" on page 60.
Exposure Control	Click **Setting** to open the Exposure Control dialog. For more information, see "Exposure Controls" on page 42.

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Gain and Black Level Controls

The Genie series of monochrome cameras provide gain and black level adjustments for the analog signal from each CCD pixel, before the analog to digital conversion. The software gain and black level controls can make small compensations to the acquisition in situations where lighting varies and the lens iris can not be easily adjusted. The user can evaluate Gain and Black Level by using CamExpert.

Features and limitations are described below.

- Gain is expressed in decibels (dB). Range from -6dB to +12dB in 0.1dB increments. Gain is a multiplication factor to the analog signal before digitization.
- Increasing gain increases the amplitude of the analog video signal but also increases the sensor analog noise proportionately, before analog to digital conversion. An increase of 6dB doubles the signal intensity.
- Black level is applied to the sensor analog signal to shift the DC level of the video signal. Black level is an additive offset to the analog video signal before digitization.
- Black level increases the brightness of the video signal equally. Therefore any area of the video that is black will brighten to some gray level as offset is increased.
- Black level is expressed as a number ranging from -128 to 127. The offset is achieved as a change in the analog signal from the sensor where a control number change of 1 is 1/16th of a DN (digital number) pixel change. In other words, a control change of 16 is required for each change in pixel value, therefore a maximum control value of 127 will cause a black pixel (00) to have a gray value of about 8.

Gain and Offset Control via Sapera LT or GenICam Applications

Sapera	Genie Sapera parameters for Gain and Black level: **Gain** = Amplification in dB from -6.0 to 12.0 dB **BlackLevel** = DC offset in 1/16th of DN, range from -128 to 127 In CamExpert, these parameters are available under the “Sensor” tab.
GEN<i>CAM	GenICam features for Gain and Black level: **GainRaw** = Analog gain in tenth of dB (0.1 dB) **BlackLevelRaw** = Black level (offset) in 1/16 of DN

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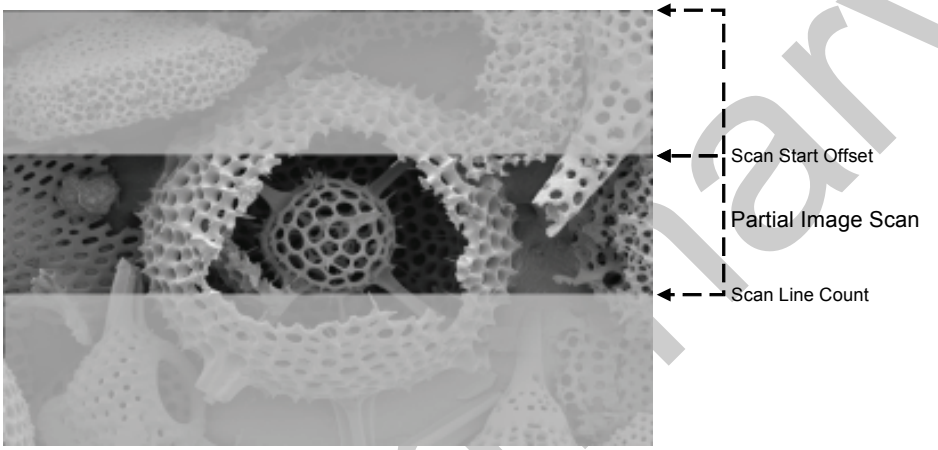
Partial Scan—Window ROI

Partial Scan (vertical cropping)

The Partial Scan mode, also know as vertical cropping, reduces the number of video lines grabbed for a frame. By not scanning the full vertical area of the sensor, the maximum possible acquisition frame rate is proportionately increased (as an extreme example, the m640 scanning a one line frame, exposed around 590 fps).



Partial Scan Illustration

Maximum Frame Rate Examples

Vertical Line Count	Maximum Frame Rate
480	64 fps
240	116 fps
120	194 fps
60	294 fps
30	394 fps
10	511 fps
1	590 fps

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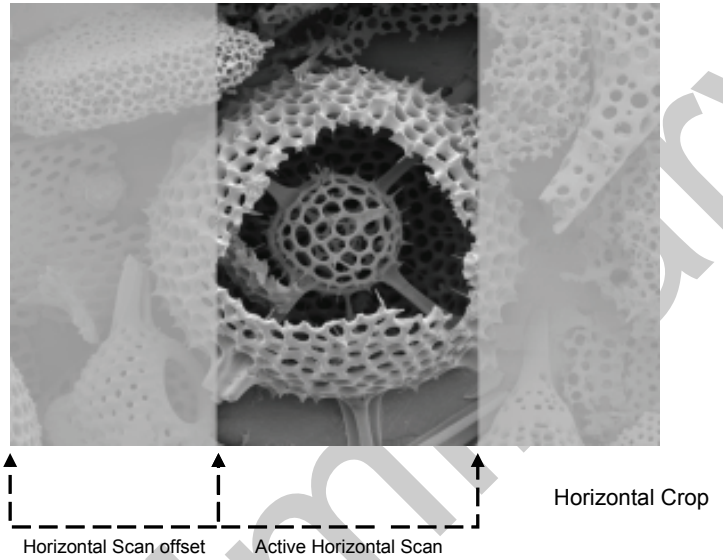
Partial Scan (horizontal cropping)

Genie also can crop the acquisition horizontally by grabbing less pixels on each horizontal line. Additionally a horizontal offset value will start the grab from any pixel count, as shown in the following figure. Note that horizontal cropping does not increase the maximum frame rate due to the CCD readout architecture.



Window ROI

Vertical and Horizontal Cropping can be combined to grab only a region of interest (ROI). Besides eliminating post acquisition image cropping done by software in the host computer, a windowed ROI grab reduces the bandwidth required on the Gigabit Ethernet link since less pixels are transmitted. See "CamExpert Image Buffer and ROI Parameters" on page 39 to use CamExpert to configure image cropping.

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Window ROI Control via Sapera LT or GenICam Applications

Sapera	Genie Sapera parameters for Partial Scan and Window ROI: **Width** = Buffer width in pixels **Height** = Buffer height in lines **OffsetX** = Horizontal Offset in pixels of the leftmost pixel relative to the sensor **OffsetY** = Vertical offset in lines of the uppermost pixel relative to the sensor **PixelFormat** = {Monochrome 8-bit}

GEN<i>CAM	GenICam features for Partial Scan and Window ROI: **Width** = Width of image/area of interest **Height** = Height of image/area of interest **OffsetX** = Left coordinate of area of interest **OffsetY** = Top coordinate of area of interest **LinePitch** = Distance between consecutive lines in bytes **PixelColorFilter** = Color filter convention of the image **PixelFormat** = Format of the image pixels as per GigE Vision specification **PixelDynamicRangeMin** = Minimum pixel value sent by camera **PixelDynamicRangeMax** = Maximum pixel value sent by camera

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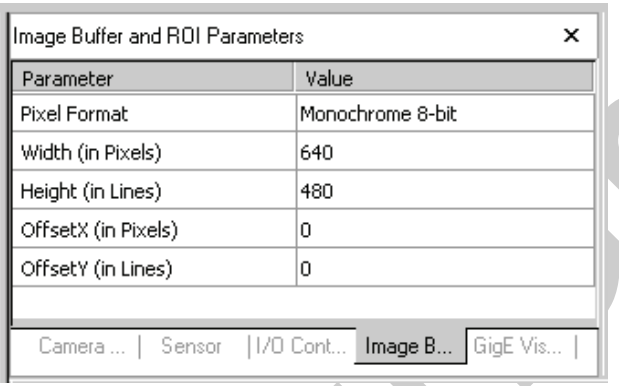
CamExpert Image Buffer and ROI Parameters

CamExpert provides controls to configure the acquisition image buffer and ROI via the Image Buffer and ROI Parameters tab. The image buffer can be easily cropped as desired. Below is the CamExpert dialog and parameter descriptions follow.



Parameter	Description
Pixel Format	For the Genie Monochrome series, the image buffer format is always Monochrome 8-bit.
Width (in Pixels)	Displays the image buffer width (X axis), in pixels.
Height (in Pixels)	Displays the image buffer height (Y axis), in pixels.
OffsetX (in Pixels)	Specifies the offset in X, from the left of the image, when using an ROI. The image buffer width is automatically adjusted to compensate for this offset.
OffsetY (in Lines)	Specifies the offset in Y, from the top of the image, when using an ROI. The image buffer height is automatically adjusted to compensate for this offset.

Note: When operating in binning mode, the resolution is halved and the coordinate system is scaled accordingly. For instance, an OffsetX of 20 pixels at nominal resolution is equivalent to an OffsetX of 10 pixels with horizontal binning enabled.

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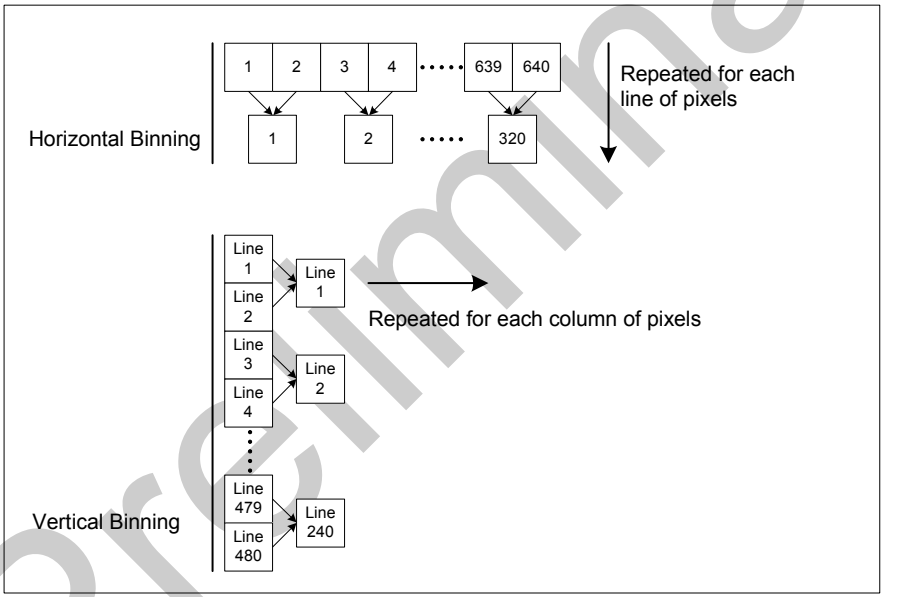
Binning

Binning is the process where the charge on two (or more) adjacent pixels is combined. This results in increased light sensitivity since there is twice the sensor area to capture photons. The sensor spatial resolution is reduced but the improved low-light sensitivity plus lower signal-noise ratio may solve a difficult imaging situation. The user can evaluate binning by using CamExpert.

Genie supports horizontal and vertical binning independently, by a factor of 2 in each axis. Specifically if horizontal binning only is activated, a nominal 640x480 image is reduced to 320x480. If vertical binning only is activated, the image is reduced to 640x240. With both binning modes activated, the resulting image is 320x240.

Vertical binning also provides an increase in maximum acquisition frame rate. The frame rate increase depends on the camera model and amount of vertical cropping used. The following graphic illustrates binning.



Horizontal and Vertical Binning Illustration

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Binning Control via Sapera LT or GenICam Applications

Sapera	Genie Sapera parameters for Binning: **BinningHorizontal** = {Disabled = 1, 2 pixels = 2} **BinningVertical** = {Disabled = 1, 2 lines = 2} In CamExpert, these parameters are available under the “Sensor” tab.

GEN<i>CAM	GenICam features for Binning: **BinningHorizontal** = Number of horizontally binned cells (1 = no binning) **BinningVertical** = Number of vertically binned cells (1 = no binning)

Trigger Modes

Genie image exposures are initiated by an event. The trigger event is either the camera's programmable internal clock used in free running mode, an external input used for synchronizing exposures to external triggers, or a programmed function call message by the controlling computer. These triggering modes are described below.

- **Free running (trigger disabled)**: The Genie free-running mode has a programmable internal timer for frame rate and a programmable exposure period. Frame rate is 0.1 fps to the maximum supported by the sensor. Exposures range from 100 µs to a maximum also dependent on the current frame rate. This always uses Synchronous mode where exposure is aligned to the sensor horizontal line timing.
- **External trigger**: Exposures are controlled by an external trigger signal. External signals are isolated by an opto-coupler input with a time programmable debounce circuit. See "General Inputs" on page 49. The following section provides information on external trigger timing.
- **Software trigger**: An exposure trigger is sent as a control command via the Ethernet network connection. Software triggers can not be considered time accurate due to network latency and sequential command jitter. But a software trigger is more responsive than calling a single-frame acquisition (Snap command) since the latter must validate the acquisition parameters and modify on-board buffer allocation if the buffer size has changed since the last acquisition.

Preliminary

Exposure Controls

Exposure Control modes define the method and timing of how to control the sensor integration period. The integration period is the amount of time the sensor is exposed to incoming light before the video frame data is transmitted to the controlling computer.

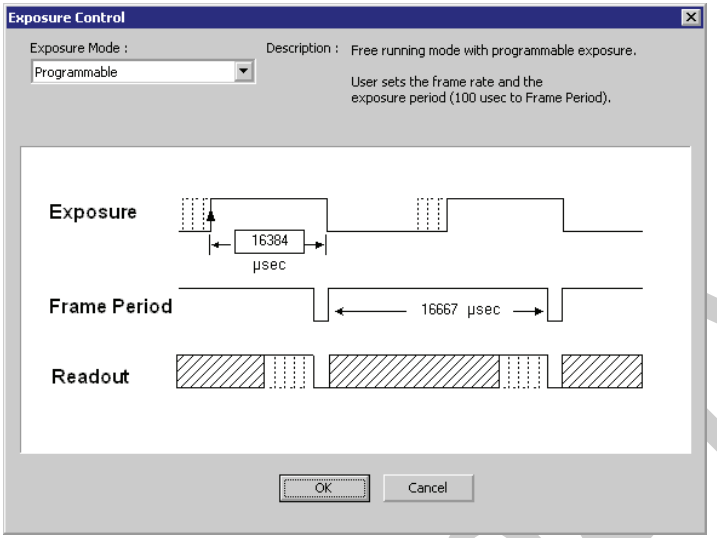
- Exposure control is defined as the start of exposure and exposure duration.
- The start of exposure can be an internal timer signal (free-running mode), an external trigger signal, or a software function call trigger.
- The exposure duration can be programmable (such as the case of an internal timer) or controlled by the external trigger pulse width.
- For the Genie camera, exposure control modes are Free-running Programmable Exposure (timer), External Trigger Programmable Exposure (timer) and External Trigger Level-controlled Exposure (trigger pulse width). Following are details for each mode.

Free-running Programmable Exposure

Genie is in a multifunctional free running mode with the following features:

- Internal trigger programmable from maximum sensor frame rate down to 0.1Hz.
- Exposure duration is user programmable (exposure maximum is dependent on the frame rate). Minimum exposure is 100µs.
- Supports vertical and horizontal binning.
- Exposure synchronization timing is Synchronous Mode where the exposure is aligned with the sensor horizontal line timing and the next acquisition is triggered by an internal programmable timer.
- Image readout is simultaneous where the grabbed image frame is readout during the next frame exposure time. This allows for fastest possible frame rates. See the timing diagram below.

Preliminary

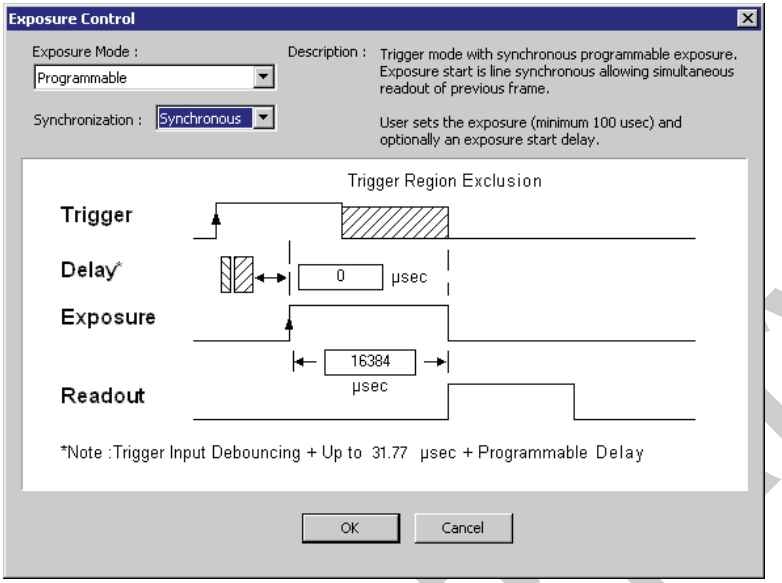


Free-running Programmable Exposure Timing

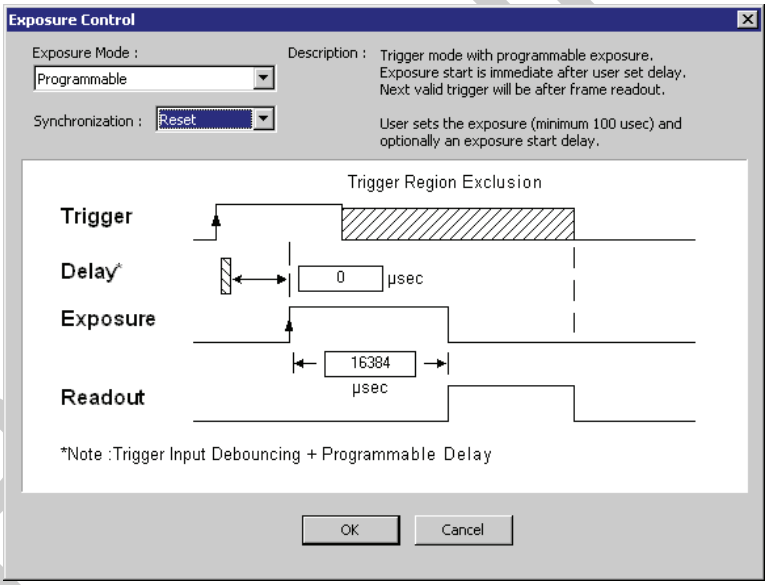
External Trigger Programmable Exposure

- Also known as “Edge Pre-select” exposure. See the timing diagram below.
- The external trigger edge initiates the exposure process. The active external trigger edge can be selected as either the low-high or high-low transition.
- The delay from active trigger edge to start of exposure is programmable from 1µs to 4 seconds (1µs steps) .
- Exposure duration is programmable from 100µs to 4 seconds (1µs steps).
- Supports Synchronous Mode timing for fastest possible frame rates. Start of exposure is aligned on the next horizontal line while exposure duration granularity is 1µs. Exposure and sensor readout can be concurrent.
- Supports Reset Mode timing. Exposure granularity is 1µs. Exposure and sensor readout must be sequential, limiting the maximal frame rate.
- Any external trigger received before the previous exposure is complete is ignored. An application can elect to receive messages about ignored triggers. See "Events" on page 62.

Preliminary



Programmable Synchronous Mode Exposure Timing

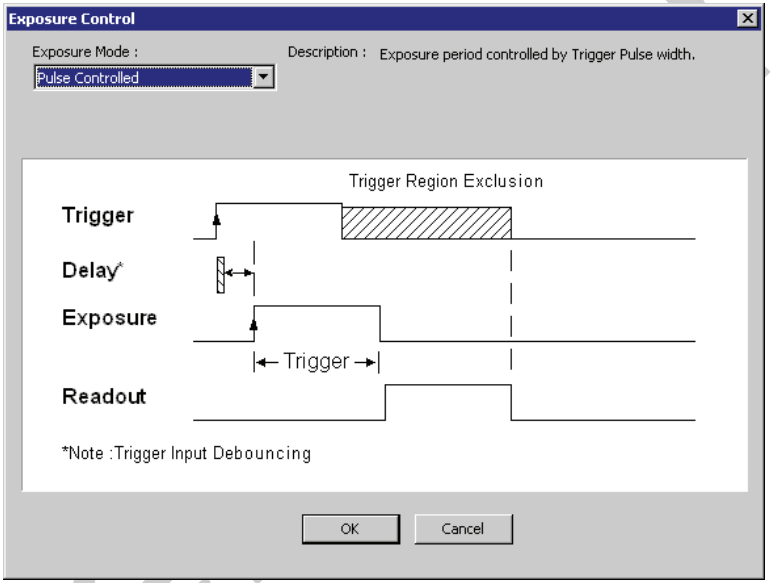


Programmable Reset Mode Exposure Timing

P r e l i m i n a r y

External Trigger Level-controlled Exposure

- Also known as “Pulse Width Control” exposure. See the timing diagram below.
- The external trigger edge initiates the exposure process. The active external trigger edge can be selected as either the low-high or high-low transition.
- No delay from active trigger edge to start of exposure.
- Exposure is stopped by the opposite edge on the trigger signal. Therefore the exposure time is defined by the trigger pulse duration.
- Supports Reset Mode trigger timing only.



External Trigger Level-controlled Exposure Timing

Exposure Controls via Sapera LT or GenICam Applications

Sapera	Genie Sapera parameters for Exposure Control: **FrameRate** = 0.1 Hz up to max. frame rate supported by sensor in current mode of operation. Only available with Trigger disabled. **ExposureMode** = {Programmable = 1, Pulse Controlled = 2} **ExposureTime** = Exposure duration in µs In CamExpert, these parameters are available under “Sensor” tab.

Preliminary

GEN<i>CAM	GenICam features for Exposure Control: **ExposureMode** = {Off = 0, Timed = 1, TriggerWidth = 2, TriggerControlled = 3, ResetContinuous = 4} **ExposureTimeRaw** = Exposure duration in µs **AcquisitionFrameRate** = Controls the desired frame rate of the camera in mHz (0.001 Hz). Only available when trigger is disabled. **AcquisitionFrameCount** = Number of frames to be acquired in MultiFrame acquisition mode **AcquisitionMode** = {Continuous = 0, SingleFrame = 1, MultiFrame = 2} **AcquisitionStart** = Start image capture using currently selected acquistion mode **AcquisitionStop** = Stop image capture **AcquisitionAbort** = Abort image capture

Synchronization Timing

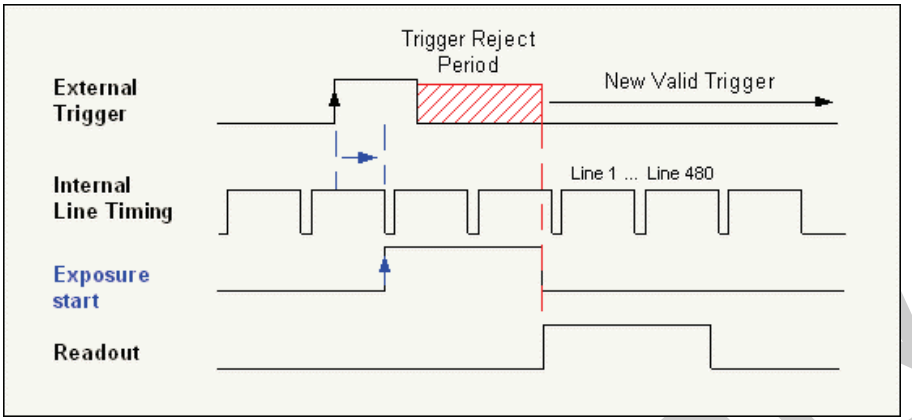
Genie cameras support two types of sensor synchronization used to align the exposure to sensor timing:

- **Synchronous Mode**: Exposure is synchronous to the line timing of the sensor. Exposure granularity is 1µs and the readout can be concurrent to the exposure for the fastest possible frame rate.
- **Reset Mode**: Timing is reset to initiate exposure of next frame. Exposure granularity is 1µs, but readout must be sequential to exposure, reducing the maximum achievable frame rate.

Synchronous Mode

- Synchronous mode starts the exposure period aligned to the sensor horizontal line timing and the programmable duration granularity is 1µs.
- In the case of the Genie M640, a horizontal line occurs every 31.77µs.
- Exposure duration is from a minimum of 100µs up to 4 sec.
- In this mode, sensor exposure and sensor readout of the previous frame's exposure occur simultaneously. This allows operating the sensor up to its maximum frame rate.
- Any trigger received before the end of the exposure is ignored. The application can elect to receive messages about ignored triggers. See "Events" on page 62.
- Since the external trigger is asynchronous with the Genie horizontal line timing, the frame exposure start is subject to 1 horizontal line jitter.

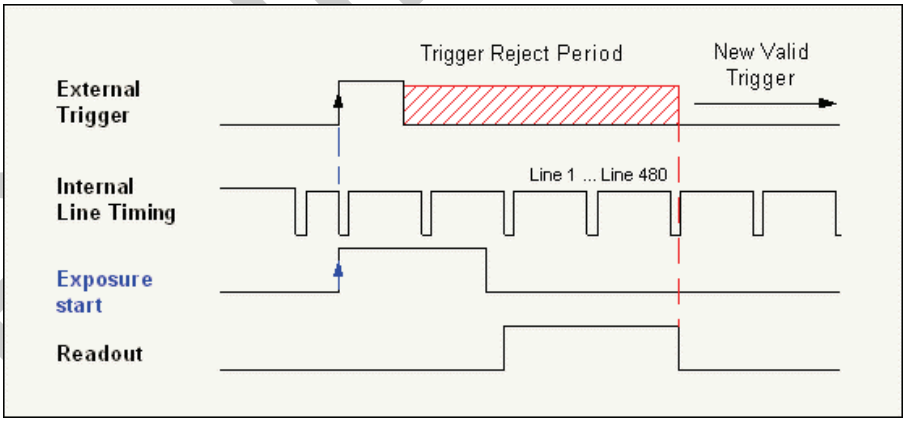
Preliminary



Synchronous Mode Timing example for Genie M640

Reset Mode

- Exposure starts immediately after a valid trigger. There is no jitter on the start of exposure.
- Exposure time is programmable or controlled by the trigger pulse width.
- Minimum exposure is 100 µs, maximum is 4 seconds, with a control granularity of 1µs.
- Sensor readout must complete before the next exposure can start. That is, exposure and readout are sequential. Therefore, the maximum frame rate is lower than for Synchronous mode.
- Any external trigger received before the previous exposure/read out sequence is complete is ignored. An application can elect to receive messages about ignored triggers. See "Events" on page 62.



Reset Mode Timing example for Genie M640

Preliminary

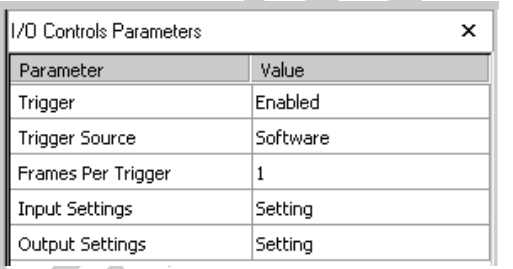
Synchronization Mode via Sapera LT or GenICam Applications

Sapera	Genie Sapera parameters for Synchronization Mode: **ExposureAlignment** = {Synchronous = 0, Reset = 1} In CamExpert, these parameters are available under the “Sensor” tab in the “Exposure Control” dialog box.

GEN<i>CAM	GenICam features for Synchronization Mode: **SensorSynchronization** = {Synchronous = 0, Reset = 1}

CamExpert I/O Controls Dialog

CamExpert groups the Genie I/O Controls Parameters in one group. These parameters allow configuring the Genie inputs and outputs for type of signal and signal polarity. The screen capture below shows the CamExpert I/O parameters dialog and is followed by a descriptive overview. Detailed information on inputs and outputs follow this section.



Parameter	Description
Trigger	Enables or disables the Genie camera trigger.
Trigger Source	Specifies the trigger source. Possible values are Software, Input 1, or Input 2. Note that this field is only available when the Trigger parameter is Enabled.
Trigger Frame Count	Set the number of frames acquired per trigger.
Input Settings	Click on **Setting** to open the **Input Settings** dialog box, which allows you to specify the trigger input settings. For more information, see "General Inputs: Settings Via CamExpert" on page 49.
Output Settings	Click on **Setting** to open the **Output Settings** dialog box, which allows you to specify the trigger output settings. For more information, see "General Outputs: Settings via CamExpert" on page 51.

For more information on triggers, see "General Inputs" on page 49.

Preliminary

General Inputs

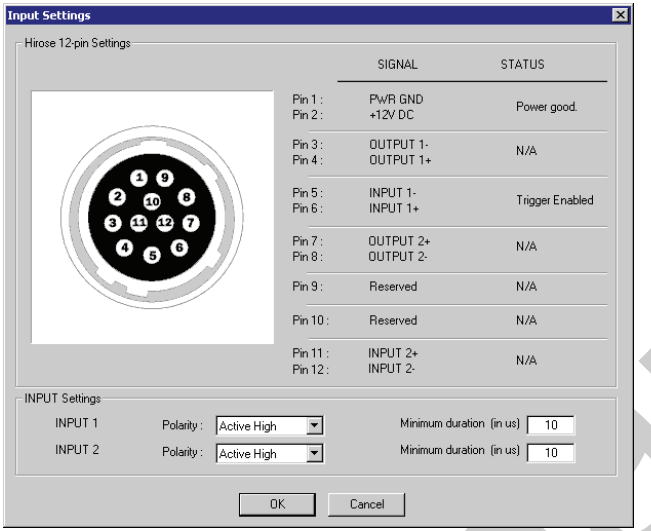
External Input Signal Opto-coupler & Debounce Circuit

- Genie provides two sets of opto-coupled inputs for either RS422 or TTL signals. These can be used as external trigger sources.
- See "12-Pin Hirose Connector Signal Details" on page 91 for connector pinout and electrical information. The cable shell and shield should electrically connect the Genie chassis to computer chassis for maximum EMI protection.
- For external triggers, a rising edge signal is suggested to minimize the time it takes for the opto-coupler to change state. (The opto-coupler response time is typically 10µs for rising edge compared to 50µs for falling edge).
- Each input incorporates a signal debounce circuit (following the opto-couple) to eliminate short noise transitions that could be wrongly interpreted as a valid pulse. The duration is user-programmable from 1µs to 255µs with CamExpert.
- Note, the external trigger input propagation delay is dependent on the signal used to activate the opto-coupled input. Typical delays are 3 µs for Active Open and 5 µs for Active Close.

General Inputs: Settings Via CamExpert

CamExpert provides control of inputs via the I/O Controls Parameters tab. The **Input Settings** dialog box allows you to view the signal and status for each pin on the Hirose connector. The **Polarity** drop-down list boxes, located in the **INPUT Settings** area, allow you to specify the polarity of the Input 1 and Input 2 as either **Active High** or **Active Low**. The **Minimum duration** field for each input, allows you to specify the minimum trigger length (1-255µs) so that input transitions are debounced to prevent unwanted trigger events.

Preliminary



Input Controls via Sapera LT or GenICam Applications

Sapera	Genie Sapera parameters for Trigger Modes and General Inputs: **TriggerDelayToIntegration** = Delay in µs from trigger to exposure **TriggerEnable** = {FALSE, TRUE} **TriggerSource** = {Input 1 = 0, Input 2 = 1, Software = 2} **TriggerSoftware** = {FALSE, TRUE} **PolarityInput_x** = {Active High = 0, Active Low = 1} **DebounceInput_x** = debouncing period in µs (from 1 to 255 µs)

GEN<i>CAM	GenICam features for Trigger Modes and General Inputs: **TriggerMode** = {Off = 0, On = 1} **TriggerSoftware** = Generates a software trigger to start the acquisition in software trigger mode **TriggerSource** = {Line2 = 1, Software = 2} **TriggerActivation** = {LevelLow = 0, LevelHigh = 1} **TriggerDelayAbs** = Absolute delay to apply in us after reception of the trigger signal before starting exposure

Preliminary

Strobe and General Outputs

Genie provides two sets of opto-coupled outputs (see "External Outputs" on page 93). These can be used as a strobe signal to control lighting or to generate programmable pulses when specific events are generated by the camera. They can also be set to a static state (close or open) by the application.

See "12-Pin Hirose Connector Signal Details" on page 91 for connector pinout and electrical information.

General Outputs: Settings via CamExpert

The **Output Settings** dialog box allows you to configure the event mode for both output 1 and output 2. Each output can be set independently to one of the available event modes. A typical usage of output is to control a strobe light in relation to the camera exposure. Select the output to configure by clicking on the **Output 1** or **Output 2** buttons located at the top of the dialog box. Use the **Event mode** drop-down list box to select the required event mode.

The following event modes are available:

- Open (default)
- Close
- Strobe On: Start of Exposure (used for strobe pulse)
- Pulse On: Valid Trigger
- Pulse On: Invalid Trigger
- Pulse On: Start of Readout
- Pulse On: End of Readout
- Pulse On: End of Acquisition
- Pulse On: Input 1
- Pulse On: Input 2

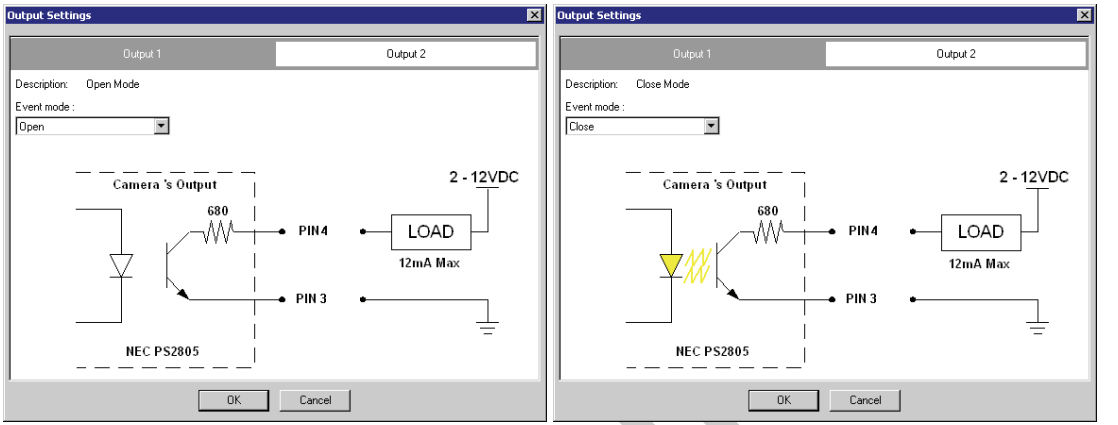
When an event mode is selected, its trigger output schematic or signal timing diagram is displayed, as well as any other additional parameters for the mode.

For most event modes, the trigger output signal can be set to either Active Open (that is high with the load connected to a voltage source) or Active Closed (where current is drawn through the load). The output delay can be set from 0 to 4 seconds, in increments of 1 µs. The pulse duration can be set from 100µs to 4 seconds, in increments of 1 µs.

Preliminary

Open and Close Output Settings

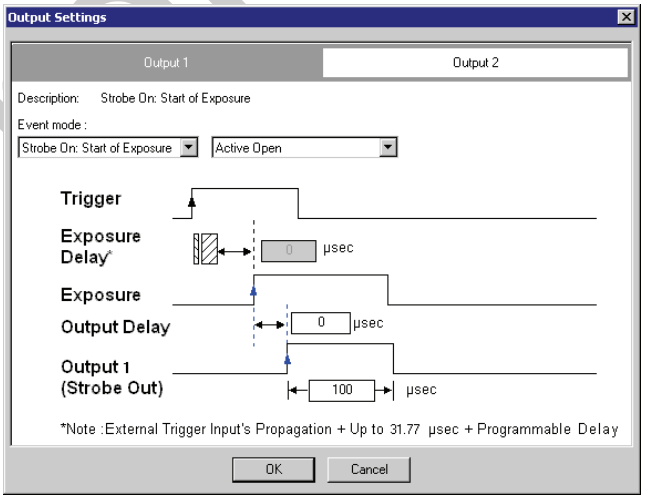
You can open and close the output circuit using software rather than hardware events, to control external devices. To control the output setting with Sapera LT see "Output Control via Sapera LT or GenICam Applications" on page 56.



Strobe On Start of Exposure Event Mode

The Strobe On Start of Exposure event mode is used when controlling a strobe light using the Genie output pin. The exposure delay parameter is specified using the Sensor Parameters tab Exposure Control setting.

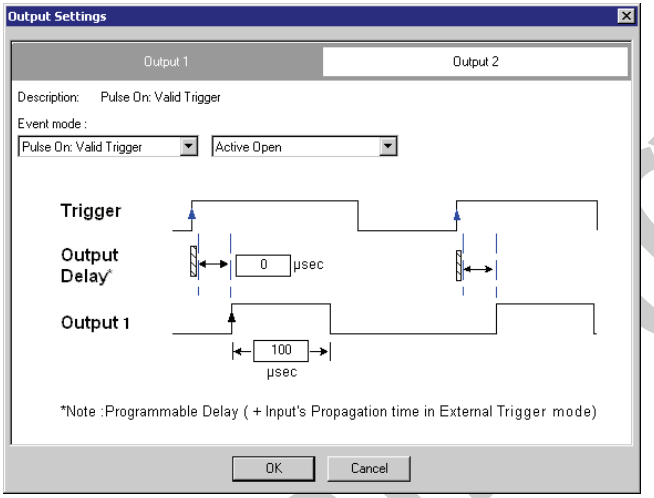
For Synchronous mode, the exposure start timing is aligned to the line period of the sensor. This can delay the start of exposure by an amount of up to 31.77µs for the Genie M640. For more information on exposure synchronous time see "Exposure Controls" on page 42.



Preliminary

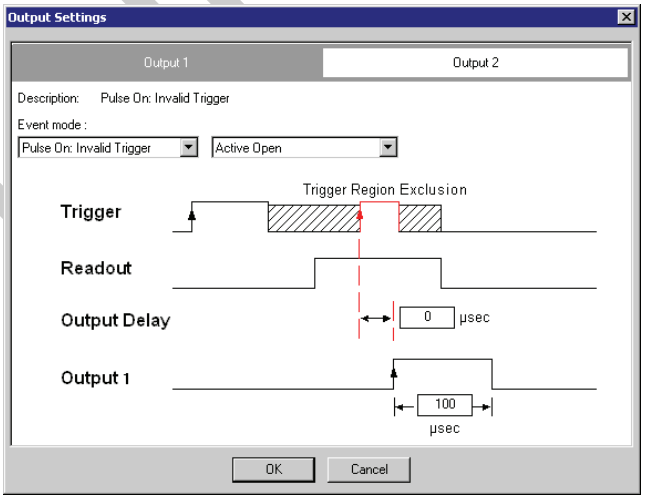
Pulse On Valid Trigger Event Mode

The Pulse On Valid Trigger event mode generates an output signal when a valid input trigger is received.



Pulse On Invalid Trigger Event Mode

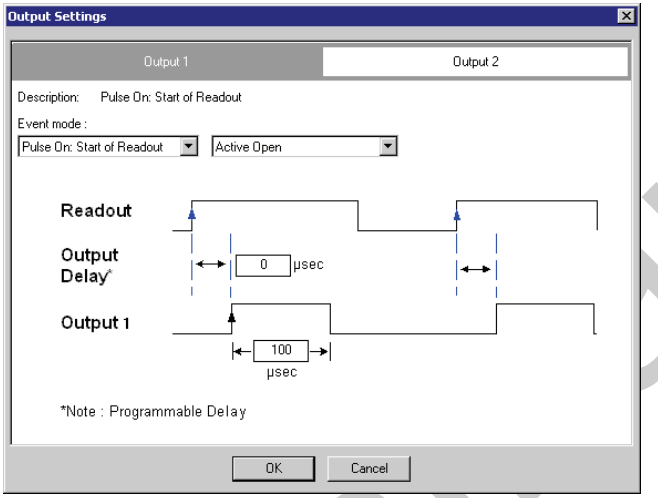
This event mode generates an output signal when an invalid input trigger is received. An invalid trigger is any trigger received while the camera is engaged in frame acquisition (exposure and readout) and cannot accept trigger inputs. This is shown by the trigger exclusion region in the following diagram.



Preliminary

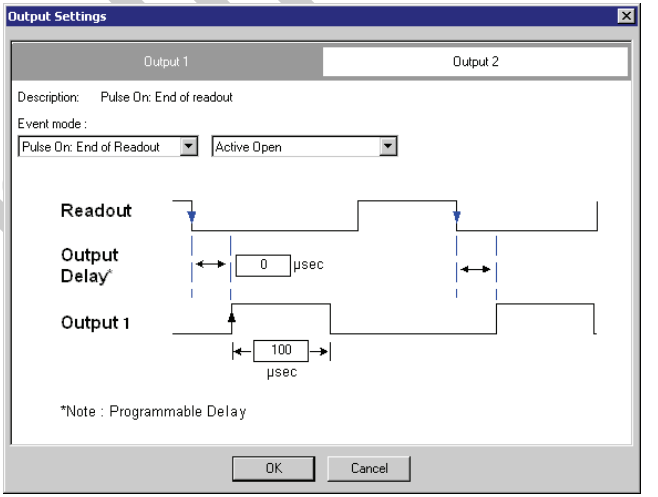
Pulse On Start of Readout Event Mode

The Pulse On Start of Readout event mode generates an output signal when the camera begins a readout operation from the sensor.



Pulse On End of Readout Event Mode

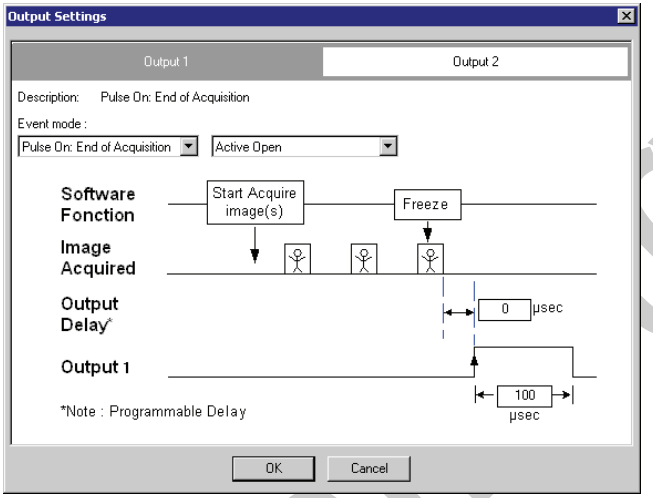
The Pulse On End of Readout event mode generates an output signal when the camera finishes a readout operation from the sensor.



Preliminary

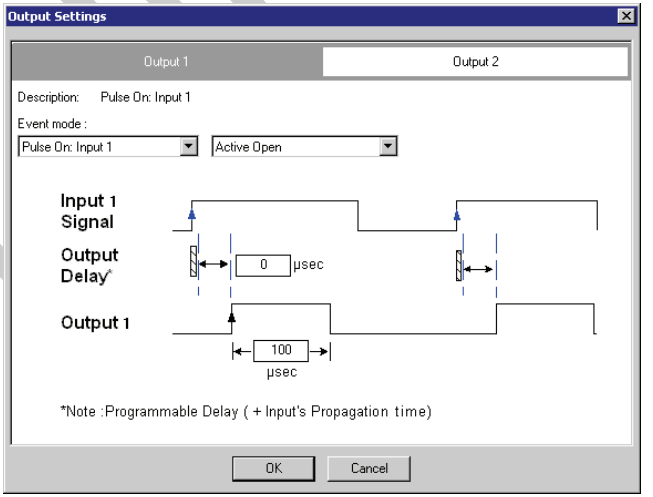
Pulse On End of Acquisition Event Mode

The Pulse On End of Acquisition event mode generates an output signal when the acquisition process is terminated using software.



Pulse On Input 1 or Input 2 Event Modes

The Pulse On Input 1 or Input 2 event modes generate an output signal when the specified input signal is asserted.



Preliminary

Output Control via Sapera LT or GenICam Applications

Sapera	Genie Sapera parameters for Strobe and General Outputs. Use the SapAcqDevice::SetFeatureValue function. **OutputSelectorOutput_x** = {Open = 0, Close = 1, Strobe On: Start of Exposure = 2, Pulse On: Valid Trigger = 4, Pulse On: Invalid Trigger = 5, Pulse On: Start of Readout = 6, Pulse On: End of Readout = 7, Pulse On: End of Acquisition = 8, Pulse On: Input 1 = 9, Pulse On: Input 2 = 10} **PulseDelayOutput_x** = Delay in µs to assert pulse output **PulseDurationOutput_x** = Pulse duration in µs **PolarityOutput_x** = {Active Close = 0, Active Open = 1}

GEN<i>CAM	GenICam features for Strobe and General Outputs: *Not supported in current version*

Genie Processing Features

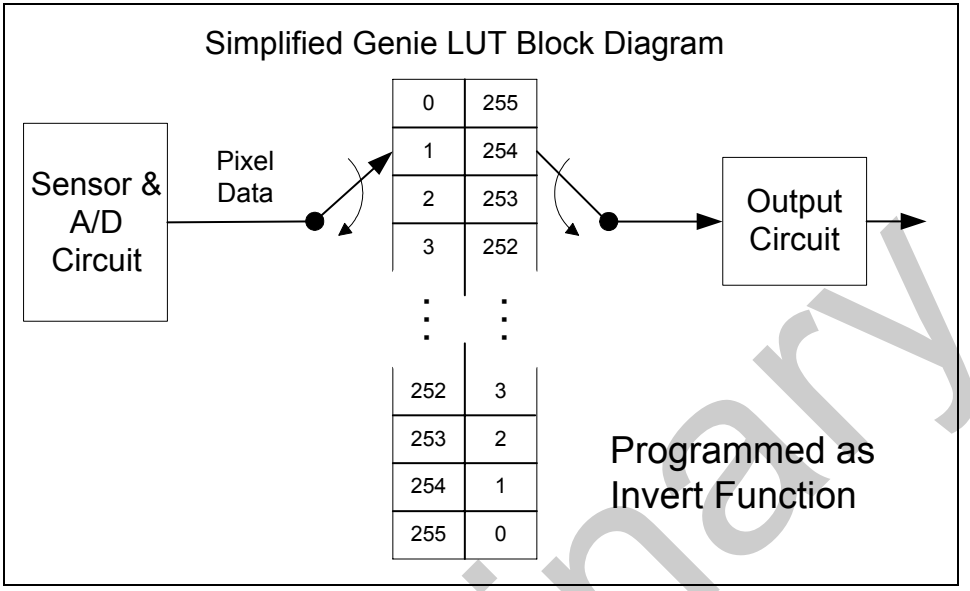
The Genie monochrome series of cameras support a number of functions to enhance acquisitions or perform real time processing. Functions can be combined to solve specific imaging situations. The user can enable and evaluate each operation by using CamExpert.

Lookup Table (LUT)

The Genie camera includes a user programmable LUT as a component of its embedded processing features. The LUT is used for operations such as gamma adjustments, invert and threshold processes. CamExpert has a number of built in LUT operations for the user to explore (see "CamExpert LUT Controls" on page 87).

For monochrome sensors, the LUT table is a single 8-bit LUT (8-bit in, 8-bit out) as illustrated in the following figure. Pixel data when read out of the sensor is passed through the LUT memory array, where the new programmed pixel value is then passed to the Genie output circuit. The LUT data table is stored along with other parameters with the user configuration function (see "Power-up Configuration" on page 30).

Preliminary



Simplified LUT Block Diagram

LUT Control via Sapera LT or GenICam Applications

Sapera	Genie Sapera parameters for LUT: **LUTEnable** = {FALSE, TRUE} **LUTFormat** = {Mono 8 – Unsigned} **LUTNumberEntries** = Number of entries in the LUT (256 for an 8-bit LUT) **LUTData** = Array of data representing the LUT content Sapera++ classes used: SapLut Class implements LUT management. SapAcquisition::GetLut to get a valid SapLut object. SapAcquisition::ApplyLut to program the SapLut object. In CamExpert, these features are available from the "Pre-Processing" menu.
GEN<i>CAM	GenICam features for LUT: *Not supported*

Preliminary

Flat Field (Image Shading) Correction

Image Shading correction, also know as Flat Field Correction is the process of eliminating small gain differences between pixels in a sensor array. That sensor when exposed to a uniformly lit field will have no gray level differences between pixels when calibrated flat field correction is applied to the image. The Genie camera stores flat field correction data until power off or in its user setting state for recall at any time (see "Power-up Configuration" on page 30). Flat field correction data is composed of 8 bit gain and 8 bit offset coefficients

The CamExpert Flat Field Correction tool allows calibrating. saving, and loading the flat field calibration data for any Genie camera being controlled.

Before performing calibration, verify Genie acquisition with a live grab. Also at this time make preparations to grab a flat light gray level image, required for the calibration, such as a clean evenly lighted white wall or non-glossy paper. Note the lens iris position for a white but not saturated image. Additionally check that the lens iris closes well or have a lens cover to grab the dark calibration image.

Flat Field Correction Calibration Procedure

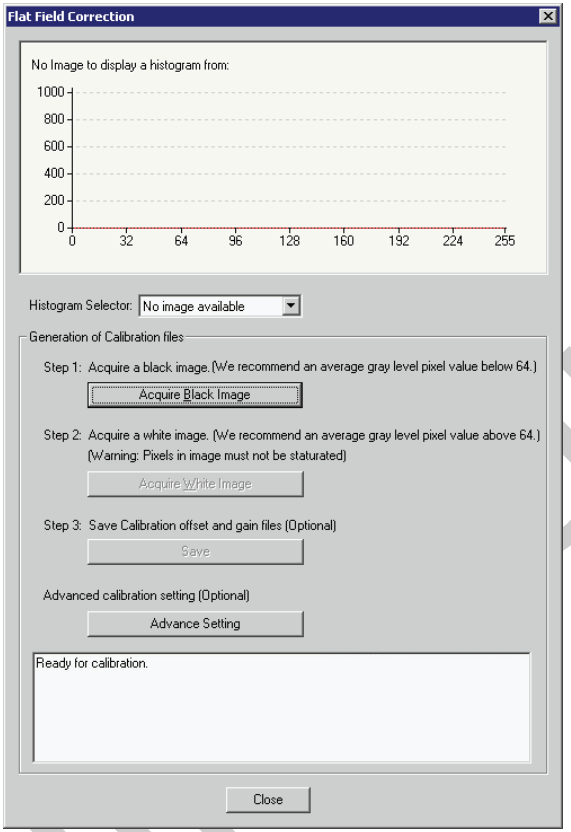
Calibration is the process of taking two reference images, one of a black field – one of a light gray field (not saturated), to generate correction data for images captured by Genie. Each sensor pixel data is modified by the correction factor generated by the calibration process, so that each pixel now has an identical response to the same illumination.

Start the Flat Field calibration tool via the CamExpert menu bar:
Pre-processing • Flat Field Correction • Calibration.

Flat Field Calibration Window

The Flat Field calibration window provides a three step process to acquire two reference images and then save the flat field correction data for the Genie used. To aid in determining if the reference images are valid, a histogram tool is provided so that the user can review the images used for the correction data.

Preliminary



CamExpert Flat Field Calibration Menu

- Click on the **Advanced Setting** button to change the default number of frames averaged for each calibration step. The default value is 10 frames.
- Setup the camera to capture a uniform black image. Black paper with no illumination and the camera lens' iris closed to minimum can provide such a black image.
- Click on **Acquire Black Image**. The flat field calibration tool will grab video frames, analyze the pixel gray level spread, and present the statistics. The desired black reference image should have pixel values less then 20. If the results are acceptable, accept the image as the black reference.
- Setup the camera to acquire a uniform white image (but not saturated white). Even illumination on white paper can be used, with a gray level of 128 minimum. It is preferable to prepare for the white level calibration step before starting the calibration procedure.
- Click on **Acquire White Image**. The flat field demo will grab video frames, analyze the pixel gray level spread, and present the statistics. The captured gray level for all pixels should be greater than 128. If acceptable accept the image as the white reference.
- Click on **Save**. The flat field correction data is saved as a TIF image with a file name of your choice (suggestions are the camera name and its serial number).

Preliminary

Using Flat Field Correction

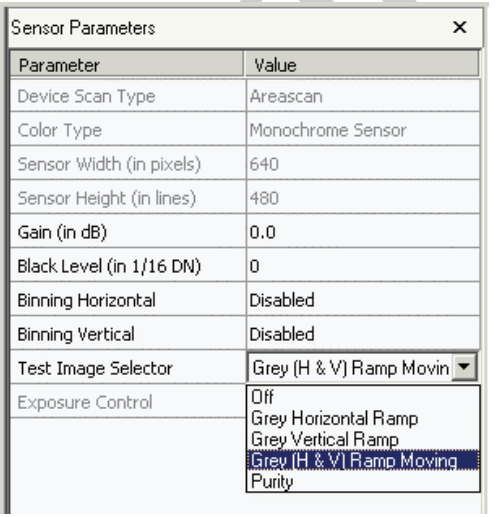
From the CamExpert menu bar enable Flat Field correction (**Pre-Processing • Flat Field Correction • Enable**). Now when doing a live grab or snap, the incoming image is corrected by the current flat field calibration data for each pixel.

Use the menu function **Tools • Flat Field Correction • Load** to load in a flat field correction image from previously saved calibration data. CamExpert allows saving and loading calibration data for all cameras used with the imaging system.

Internal Image Test Patterns

The Genie camera includes a built in test pattern generator that can be used to confirm camera Ethernet connections or driver installations, without the need for a camera lens or proper lighting. The pattern generator inserts video just after the sensor A/D converter, therefore Genie processing such as the LUT act on the generator images or on sensor images.

CamExpert is used to easily enable and select the Genie test patterns. As shown in the following figure, select the Sensor tab, then select one of the four patterns from the drop menu. Select live grab to see the pattern output.



Genie Test Pattern Selection – on Sensor Tab

Preliminary

The Genie test patterns are:

- **Horizontal ramp**: successive pixel's gray level is incremented by 1 to maximum pixel value then repeated until the end of line. The gray level is reset to 0 on the following line.

- **Vertical ramp**: similar to the horizontal ramp, successive lines are incremented by 1 gray level then repeated for the full frame.
- **Moving diagonal ramp**: combination of the 2 previous schemes, but first pixel in image is incremented by 1 between successive frames. This is a good pattern to indicate motion when doing a continuous grab.

- **Purity**: a purity pattern where all pixels have the same value. The gray value is incremented by one on successive frames to maximum then repeated. This also provides motion for live grabs.

Test Image Select via Sapera LT or GenICam Applications

Sapera	Genie Sapera parameters for Image Test Patterns: **TestImageSelector** = {Off = 0, Grey Horizontal Ramp = 1, Grey Vertical Ramp = 2, Grey Diagonal Ramp Moving = 3, Purity = 4} In CamExpert, these parameters are available in the "Sensor" tab.

GEN<i>CAM	GenICam features for Image Test Patterns: **TestImageSelector** = {Off = 0, HorizontalWedge = 1, VerticalWedge = 2, DiagonalMovingWedge = 3}

Preliminary

Events

Genie supports a number of events that a control application can monitor. Events provide real time notification on various stages of the acquisition sequence and of error conditions. A Sapera application registers callbacks for those events that need monitoring.

Two types a callbacks can be registered for events when using the Genie:

- **Transfer events** concerning host system buffers.
  - Use the Sapera Transfer Module
  - In the Sapera C library: see CorXferRegisterCallback
  - In the Sapera++ library: see SapXferCallbackInfo class
- **Acquisition events** concerning the acquisition device, specifically the Genie camera.
  - Use the Sapera Acquisition Module
  - In the Sapera C library: see CorAcqRegisterCallback
  - In the Sapera++ library: see SapAcqDeviceCallbackInfo class

Acquisition Device Event Name (case sensitive strings)	Description
Start of Trigger	Trigger is valid based on the programmed trigger parameters
Start of Exposure	Exposure has started
End of Exposure	Exposure is complete
Feature Value Changed	Parameter value is changed
Feature Info Changed	Configuration parameter is changed
Invalid Trigger	Trigger event (software or external) was invalid
Input Event 0	External Input # 1 has received a valid signal
Input Event 1	External Input # 2 has received a valid signal
Output Event 0	External Output # 1 has changed state
Output Event 1	External Output # 2 has changed state
Transfer Event Name	**Description**
End of frame transfer	Video frame transferred to host buffer

Event Selection via Sapera LT or GenICam Applications

GEN<i>CAM	GenICam features for Events: **EventSelector** = {AcquisitionTrigger = 2, ExposureStart = 3, ExposureEnd = 4} **EventNotification** = {Off = 0, GigEVisionEvent = 1}

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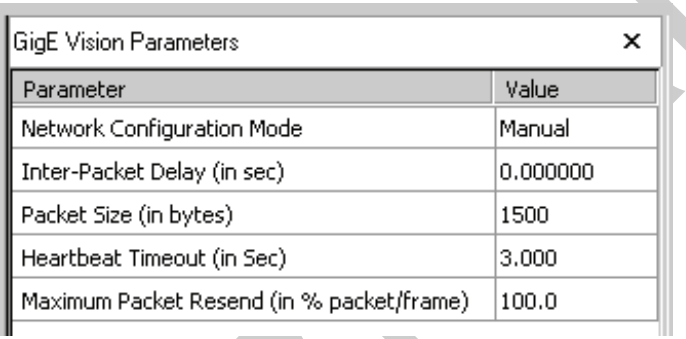
Network Controls & GigE Vision Parameters

This section describes how to optimize the network configuration for maximum Genie bandwidth. Optimization of these parameters is highly dependent on the number of cameras connected to a NIC, the data rate of each camera and the trigger modes used.

In general, the Genie driver can optimize image transfers using the **Automatic** Network Configuration mode. If this does not provide satisfactory performance, it is possible to optimize transfers by manually setting the network configuration parameters. The following screen shot of the GigE Vision Parameters shows the CamExpert control set to **Manual**. Descriptions for each parameter follow.



Parameter	Description
Network Configuration Mode	Specifies the Network Configuration Mode as either Automatic or Manual. In general, it is recommended to use Automatic mode. The following parameters can only be modified when Manual mode is selected.
Inter-Packet Delay (in sec)	Specifies the inter-packet delay, in sec. The range of permitted values is 0.000000 to 0.065535. The inter-packet delay is the minimum time interval between two successive packets. This can be increased if the NIC is unable to keep up with packet arrivals (thus dropping packets).
Packet Size (in bytes)	Specifies the maximum packet size, in bytes. The range of possible values is 576 to 1500, in increments of 4 bytes when NIC does not support jumbo packet. It can go up to 8000 bytes when jumbo packets are supported. In most situations, use the largest possible packet size supported by your network elements. In order to support jumbo packets, all intermediate network elements must support them, otherwise they will simply be silently discarded and no image data will reach the PC.
Heartbeat Timeout (in Sec)	Specifies the heartbeat timeout, in seconds. The range of permitted values is 0.5 to 65, in increments of 0.001 seconds. This is used by the camera to ensure the PC application is still linked. If the heartbeat timeout expires, the camera will shutdown the connection to the current application.

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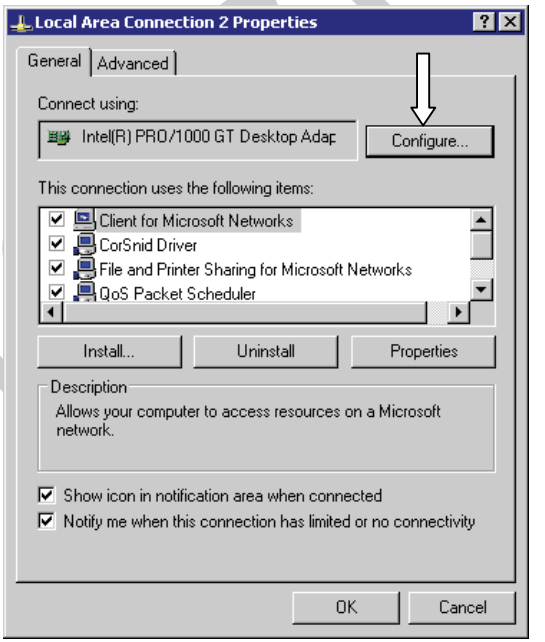
Maximum Packet Resend	Sets the percentage of packets that can be resent for each frame. This is used to ensure the streaming data (including resends) does not exceed the Ethernet link capacity. As an example, a system capturing at 80 MB/s can allow 25% of packet resends without exceeding 100 MB/s (about the maximum capacity of a gigabit Ethernet link).

Increasing Network Adapter Buffers

Under certain conditions the host PC system CPU may be very busy with tasks other than the imaging application. Incoming image packets remain in the PC memory allocated to store packets instead of immediately being copied into the image buffer. By increasing the NIC host buffers, more incoming image packets can be stored by the NIC before it must start discarding them. This provides more time for the PC to switch tasks and move image packets to the image buffer. Note the Network Configuration tool provides a field to configure the number of adapter buffers for most popular NIC.

Not all network boards allow increasing their buffer count and even among those that do, such as the Intel NIC, different versions will have different maximum receive descriptor values. Refer to the NIC user documentation for details on configuring this parameter. The following screen shots show the procedure to increase the number of packet buffers for one version of Intel network adapter.

- Open the properties for the Ethernet GigE NIC used with the Genie.
- Click the *Configure* button.



GigE NIC Configuration

- Click on the Advanced tab.

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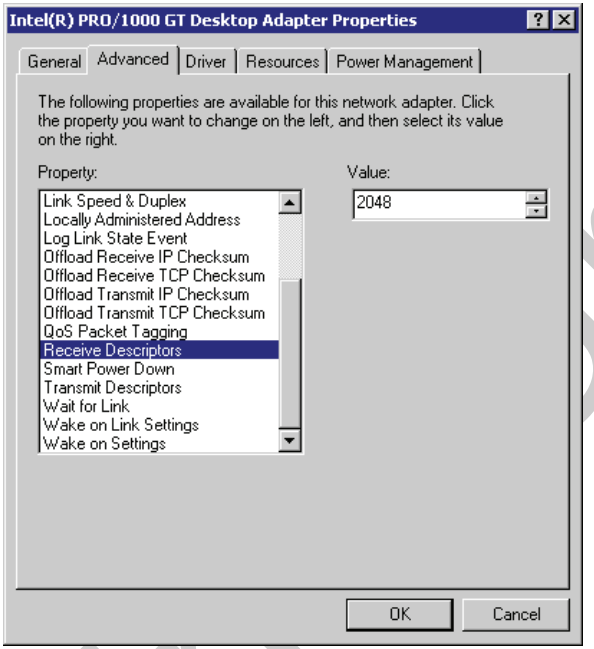
- Select the 'Receive Descriptors' property.
- Change the value to the largest value supported by the installed NIC. In this example this value is 2048.



GigE NIC Receive Buffers

Network Controls via Sapera LT or GenICam Applications

Sapera	Genie Sapera parameters for Network Configuration: **NetworkConfigurationMode** = {Automatic = 0, Manual = 1} **InterPacketDelay** = Minimum delay in µs between image packets **PacketSize** = default image packet size in bytes **HeartbeatTimeout** = Heartbeat period (watchdog) in ms before camera disconnect In CamExpert, these parameters are available under the “GigE Vision” tab.

GEN<i>CAM	GenICam features for Network Configuration: **PayloadSize** = Size of the payload in bytes. This is the total number of bytes sent in the payload. No packet headers

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Genie Power-up Configuration

On power up the Genie camera initializes to a factory default state which sets the camera with neutral parameters and in free run mode. The default state ensures that the camera is ready for acquisition. Genie also provides storage for one user-defined state. This user state allows quick camera configuration for a known repeatable imaging system. The following table describes the camera parameters stored in the user state. See "Power-up Configuration" on page 30 for information on saving the user state with CamExpert.

Parameter	Description
ROI	Region of interest used to crop the image
Pixel Format	Defines the pixel format (MONO8)
Frame Rate	Defines the frame rate for free run mode.
Exposure mode	Defines the exposure mode (Programmable or Pulse Controlled)
Exposure duration	Defines the exposure duration for Programmable mode
Exposure synchronization	Synchronous or Reset synchronization mode
Gain	Defines the sensor analog Gain factor.
Black Level	Defines the sensor analog Black level factor.
Binning	Horizontal and vertical binning factor
Image source	Defines the image source as the sensor or one of the stored image patterns.
Trigger enable	Free-running or triggered
Trigger source	Selects the trigger input (input pin or software)
Trigger delay	Defines the delay from input trigger to exposure start.
GPI settings	Defines the operational mode of the general input pins.
GPO settings	Defines the operational mode of the general output pins
LUT	Lookup Table function On or Off plus the LUT data.
Flat Field Correction	FFC function On or Off plus the offset/gain data.

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Power-up Control via Sapera LT or GenICam Applications

Sapera	Genie Sapera parameters for Power-up Configuration: **Power-upConfig** = {Factory Default = 0, Camera Configuration 1 = 1} **SaveCameraConfigurationSelector** = {Camera Configuration 1 = 1} **SaveCameraConfiguration** = Write to save selected camera configuration **LoadCameraConfigurationSelector** = {Factory Default = 0, Camera Configuration 1 = 1} **LoadCameraConfiguration** = Write to load selected camera configuration In CamExpert, these parameters are available in the "Camera Information" tab, under the "Power-up Configuration" dialog box.

GEN<i>CAM	GenICam features for Power-up Configuration: **UserSetSelector** = {Factory = 0, UserSet1 = 1} **UserSetLoad** = Loads the User Set specified by UserSetSelector to the camera and makes it active **UserSetSave** = Saves the User Set specified by UserSetSelector to the camera **UserSetDefaultSelector** = Selects the feature User Set to load at camera reset

Sapera Supported Features List

The Genie features and its currently set values can be read by a Sapera application. The Sapera tool CamExpert is an example of an application that reads and writes Genie parameters to control its operation.

The following tables group the Genie features by their feature type—STRING, ENUM, INT32, and BOOL. Features may be read only (RO), read/write (RW), or write only (WO).

Accessing Features with Sapera++ LT

When working with Genie features, the **SapAcqDevice** class provides functions for accessing features from devices such as a GigE-Vision camera. The class also contains functions for sending commands and registering events to devices.

- **SapAcqDevice::GetFeatureInfo** returns information on a feature associated with a specified name or index.
- **SapAcqDevice::SetFeatureValue** writes a new value for a feature.
- All information about the feature is stored in a **SapFeature** class object.

Refer to the Sapera++ LT Programmer's manual (OC-SAPM-SPPP0).

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Feature Type STRING

Feature Name	Access	Type	Value
Server Name	RO	STRING	Genie_M640_1 (*example*)
Number of Features	RO	STRING	(*number dependent on firmware version*)
DeviceVendorName	RO	STRING	DALSA
DeviceModelName	RO	STRING	Genie M640 (*example*)
DeviceVersion	RO	STRING	1452 (*example*)
FirmwareVersion	RO	STRING	version 7630 (*example*)
DeviceID	RO	STRING	S1234567 (*example*)
MACAddress	RO	STRING	00:01:0D:11:01:2A (*example*)
DeviceUserID	RW	STRING	Inspection-1 (*user set example*)

Feature Type ENUM

Feature Name	Access	Type	Values
Interface	RO	ENUM	GigE Vision
DeviceScanType	RO	ENUM	Area scan = 0 Linescan = 1
ColorType *(dependent on camera model)*	RO	ENUM	Monochrome Sensor = 0 CFA Bayer Sensor GR = 1 CFA Bayer Sensor RG = 2 CFA Bayer Sensor GB = 3 CFA Bayer Sensor BG = 4 Color Sensor = 5
ExposureMode	RW	ENUM	Programmable = 1 Pulse Controlled = 2
ExposureAlignment	RW	ENUM	Synchronous = 0 Reset = 1
BinningVertical	RW	ENUM	Disabled = 1 2 lines binned = 2
BinningHorizontal	RW	ENUM	Disabled = 1 2 pixels binned = 2
FlatFieldFormat *(dependent on camera model)*	RO	ENUM	Mono 8 - Unsigned = 16844800 Mono 9 - Unsigned = 16779520 Mono 10 - Unsigned = 16779776 RGB = 1124075520

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TestImageSelector	RW	ENUM	Off = 0 Grey Horizontal Ramp = 1 Grey Vertical Ramp = 2 Grey Diagonal Ramp Moving = 3 Purity = 4
LUTFormat *(dependent on camera model)*	RO	ENUM	Mono 8 - Unsigned = 16844800 Mono 8 - Signed = 285280256 Mono 9 - Unsigned = 16779520 Mono 9 - Signed = 285214976 Mono 10 - Unsigned = 16779776 Mono 10 - Signed = 285215232 RGB = 1124075520
TriggerSource	RW	ENUM	Input 1 = 0 Input 2 = 1 Software = 2
OutputSelectorOutput_1	RW	ENUM	Open = 0 Close = 1 Strobe On: Start of Exposure = 2 Pulse On: Valid Trigger = 4 Pulse On: Invalid Trigger = 5 Pulse On: Start of Readout = 6 Pulse On: End of Readout = 7 Pulse On: End of Acquisition = 8 Pulse On: Input 1 = 9 Pulse On: Input 2 = 10
OutputSelectorOutput_2	RW	ENUM	Open = 0 Close = 1 Pulse On: End of Exposure = 3 Pulse On: Valid Trigger = 4 Pulse On: Invalid Trigger = 5 Pulse On: Start of Readout = 6 Pulse On: End of Readout = 7 Pulse On: End of Acquisition = 8 Pulse On: Input 1 = 9 Pulse On: Input 2 = 10
PolarityInput_1	RW	ENUM	Active High = 0 Active Low = 1
PolarityInput_2	RW	ENUM	Active High = 0 Active Low = 1
PolarityOutput_1	RW	ENUM	Active Close = 0 Active Open = 1
PolarityOutput_2	RW	ENUM	Active Close = 0 Active Open = 1
PixelFormat	RW	ENUM	Monochrome, 8-bit = 17301505 (0x1080001)

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Power-upConfig	RW	ENUM	Factory Default = 0 Camera Configuration 1 = 1
SaveCameraConfigurationSelector	RW	ENUM	Camera Configuration 1 = 1
LoadCameraConfigurationSelector	RW	ENUM	Factory Default = 0 Camera Configuration 1 = 1
NetworkConfigurationMode	RW	ENUM	Automatic = 0 Manual = 1

Feature Type INT32

The feature list for type INT32 has an additional column 'Exponent' which defines the feature's native unit. This exponent value is used as a unit multiplier so that the feature value is expressed as an integer, not a decimal number.

- As an example from the following table, the Genie frame rate is 60000 with an exponent of 3. Therefore the frame rate native unit is mHz. The current value shown – 60000 mHz, is actually 60.000 Hz.

Feature Name	Access	Type	Exponent	Sample Value
DeviceMaxThroughput	RO	INT32	EXP10: 0	18432000
SensorWidth	RO	INT32	EXP10: 0	640
SensorHeight	RO	INT32	EXP10: 0	480
FrameRate (mHz)	RW	INT32	EXP10: 3	60000
BlackLevel	RW	INT32	EXP10: 0	0
Gain	RW	INT32	EXP10: 1	0
ExposureTime (µS)	RW	INT32	EXP10: 6	16384
TriggerDelayToIntegration (µS)	RW	INT32	EXP10: 6	0
LUTNumberEntries	RO	INT32	EXP10: 0	256
DebounceInput_1 (µS)	RW	INT32	EXP10: 6	10
DebounceInput_2 (µS)	RW	INT32	EXP10: 6	10
PulseDelayOutput_1 (µS)	RW	INT32	EXP10: 6	0
PulseDurationOutput_1 (µS)	RW	INT32	EXP10: 6	0
PulseDelayOutput_2 (µS)	RW	INT32	EXP10: 6	0
PulseDurationOutput_2 (µS)	RW	INT32	EXP10: 6	0
Width	RW	INT32	EXP10: 0	640
Height	RW	INT32	EXP10: 0	480
OffsetX	RW	INT32	EXP10: 0	0
OffsetY	RW	INT32	EXP10: 0	0

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SaperaBufferFormat	RO	INT32	EXP10: 0	16844800
PixelSize	RO	INT32	EXP10: 0	8
InterPacketDelay (µS)	RW	INT32	EXP10: 6	0
PacketSize	RW	INT32	EXP10: 0	1500
HeartbeatTimeout (mS)	RW	INT32	EXP10: 3	500
LUTData	RW	Buffer		
FlatFieldGainBuffer	RW	Buffer		
FlatFieldOffsetBuffer	RW	Buffer		

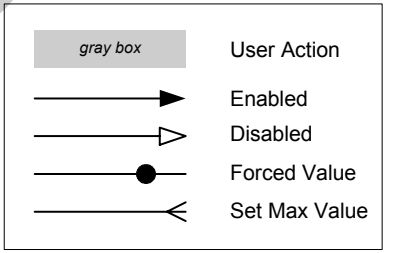
Feature Type BOOL

Feature Name	Access	Type	Value
LUTEnable	RW	BOOL	True/False
TriggerEnable	RW	BOOL	True/False
TriggerSoftware	RW	BOOL	True/False
FlatFieldEnable	RW	BOOL	True/False
SaveCameraConfiguration	WO	BOOL	True/False
LoadCameraConfiguration	WO	BOOL	True/False

Feature Interdependence Diagrams

The following diagrams describe operational feature availability dependent on user selected modes. These diagrams show what features are set to a value, and they show which feature parameters remain as user variables.

Each diagram uses the following symbol set to indicate the dependent action type.



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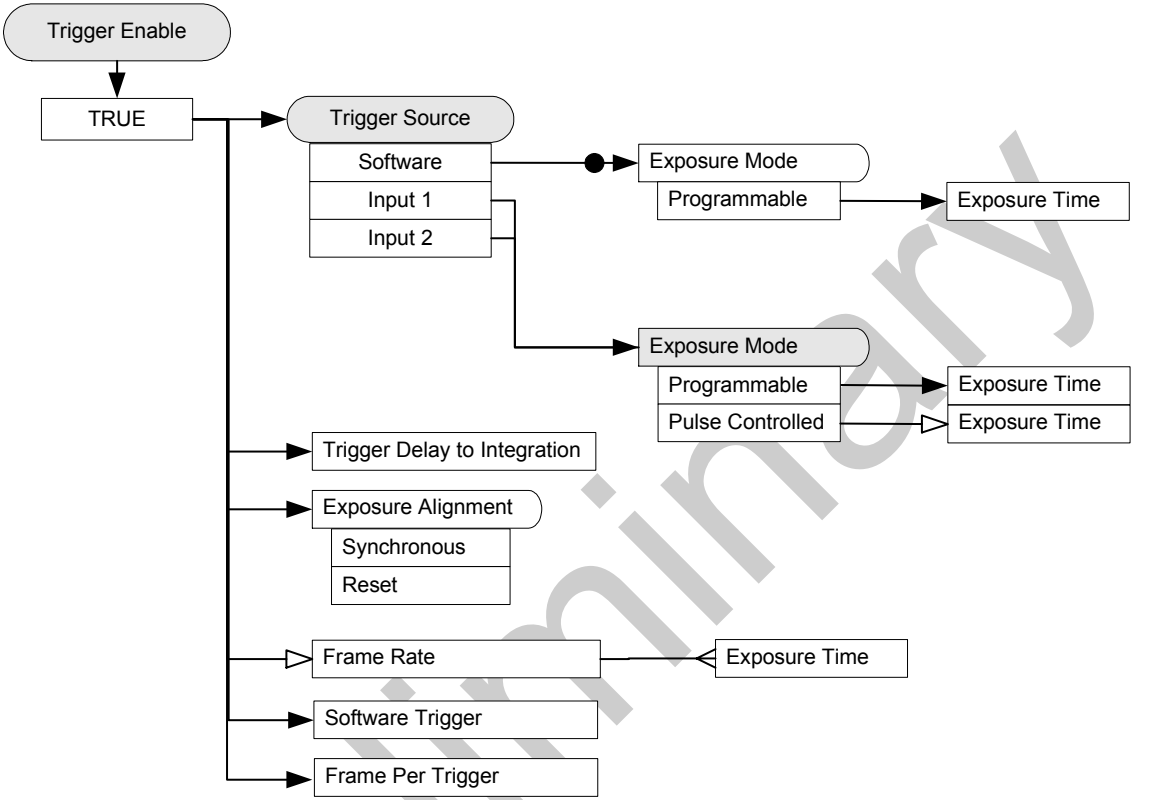
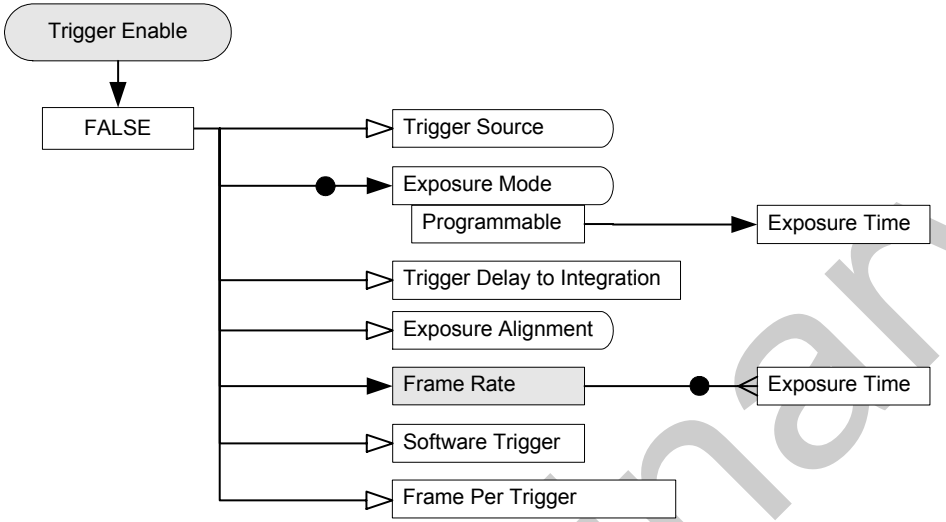
Trigger Enable - TRUE

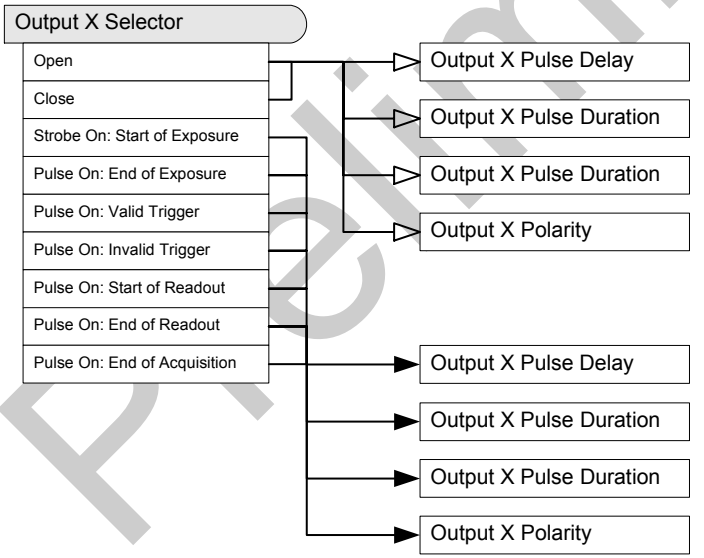


Preliminary

Trigger Enable - FALSE



Output Selector



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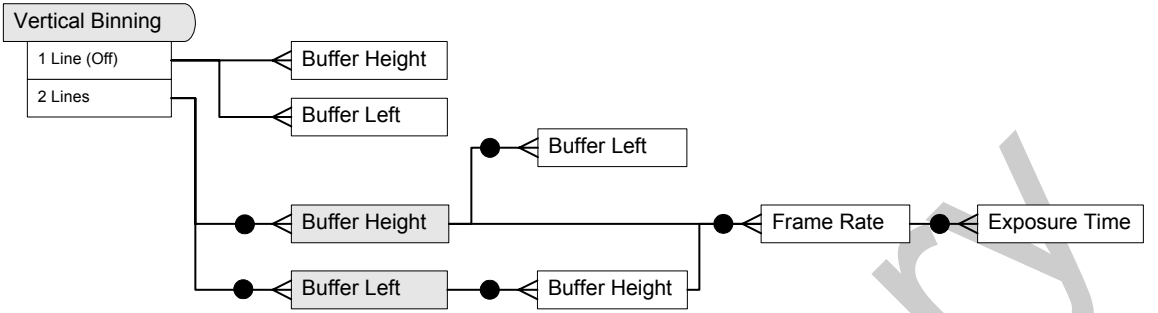
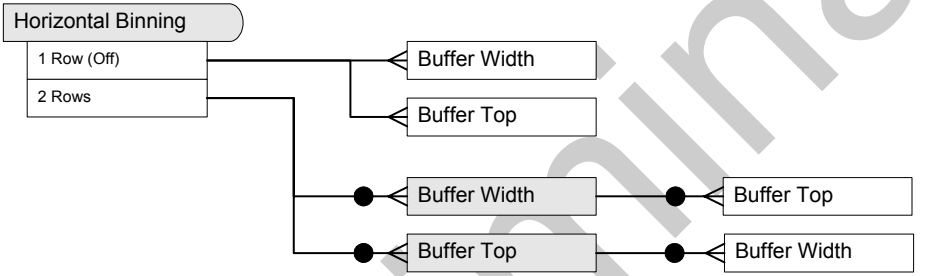
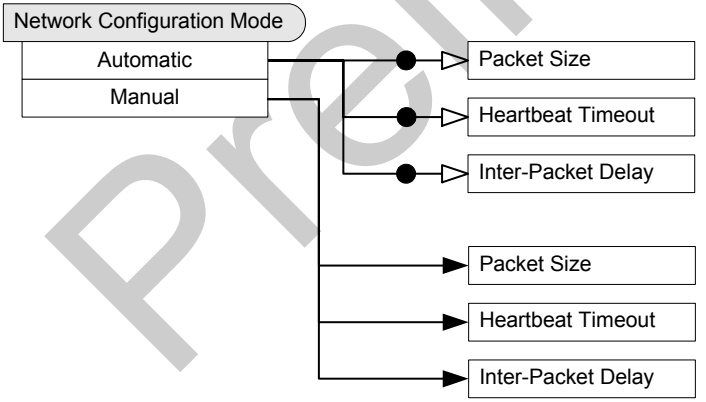
Vertical Binning



Horizontal Binning



Network Configuration Mode



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Network Tools

IP Configuration Mode Details

The following descriptions provide more information on the IP configuration modes supported by Genie. In general automatic IP configuration assignment is sufficient for most Genie installations.

Link-Local Address (LLA)

- LLA is also known as Auto-IP. It is used for unmanaged networks including direct connections from a GigE Vision device to a dedicated NIC.
- A subnet configured with LLA cannot send packets across routers but only via Ethernet switches.
- LLA is the recommended scheme when only one NIC is connected to GigE cameras. LLA is fully automatic requiring no user input. Ensure only one NIC is using LLA on your PC, otherwise IP conflicts might result.
- The NIC will automatically assign a random IP address within the 169.254.x.x subnet. The LLA protocol ensures there are no conflicts with other devices through an arbitration scheme.
- The Windows NIC configuration must be set to DHCP (the typical default case) and no DHCP server must be present on the network. Otherwise, an IP address gets assigned by the DHCP server. Windows will turn to LLA when no DHCP server answers requests coming from the NIC.
- Windows takes up to 1 minute to obtain an LLA IP address. With Windows XP, with no DHCP server involved, the network adapter icon in the system tray (in Windows XP) typically shows "limited or no connectivity". This is normal (see Microsoft KB article #892896) and indicates that the network does not have connectivity beyond routers.
- Windows and Genie are still running the DHCP process in the background. If a DHCP server becomes available on the network, the NIC will get a DHCP assigned IP address for the connected device but connections on the LLA IP address will be lost.
- Important: If the host system has multiple NIC devices configured with LLA, then the communication stack cannot accurately resolve which NIC to forward an IP packet on the 169.254 segment. Limit the number of NIC configured using LLA to one interface.
- Use the DALSA Network tool to change the Genie from the default DHCP/LLA mode to Persistent IP mode. Note that DALSA recommends DHCP/LLA as the mode of operation.

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DHCP (Dynamic Host Configuration Protocol)

- This Genie IP configuration mode requires a DHCP server to allocate an IP address dynamically. The Genie must be configured to have DHCP enabled. This is the factory default settings.
- The DHCP server is part of a managed network. Windows XP itself does not provide a DHCP server function. A dedicated DHCP server is required. Open-source DHCP server software can be found on the Internet, but they might not provide the same level of functionality as commercial-grade DHCP servers.
- A DHCP server is recommended where there are multiple NIC ports with multiple GigE Vision devices attached. Each NIC ports must use a different subnet to avoid IP address conflicts.
- Under Windows, a NIC is configured in DHCP mode by default. If no DHCP server is present on a given subnet, Windows will revert to LLA as explained in the section above.
- Ensure that a different subnet is assigned to each NIC on the network. Typical ranges are 192.168.x.x or 10.10.x.x for internal networks.

Persistent IP

- This protocol is only suggested if the user fully controls the assignment of IP addresses on the network and a GigE Vision camera is connected beyond routers.
- The GigE Vision camera is forced a static IP address. The NIC IP address must use the same subnet otherwise the camera is not accessible.
- If the Genie camera is connected to a network with a different subnet, it cannot be accessed.
- The DALSA network configuration tool is used to set a persistent IP address.
- An example of a Persistent IP address assignment:
    - Persistent IP = 192.168.1.1
    - Subnet Mask = 255.255.0.0
    - Default Gateway = 0.0.0.0
- Warning: an incorrect IP address assignment might make it impossible to connect to the camera. In such a case the DALSA network configuration tool includes a function to recover a Genie camera with an unknown persistent IP and set the Genie to the factory default setting, i.e. DHCP/LLA mode. The Genie MAC address must be known to use this function. See "Recovering a Camera with an Unknown Persistent IP" on page 81.
- For GigE Vision applications the FORCEIP command is used to force a new persistent IP or to change the IP configuration protocol. The Genie MAC address must be known to use the FORCEIP command.

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Network Configuration Tool

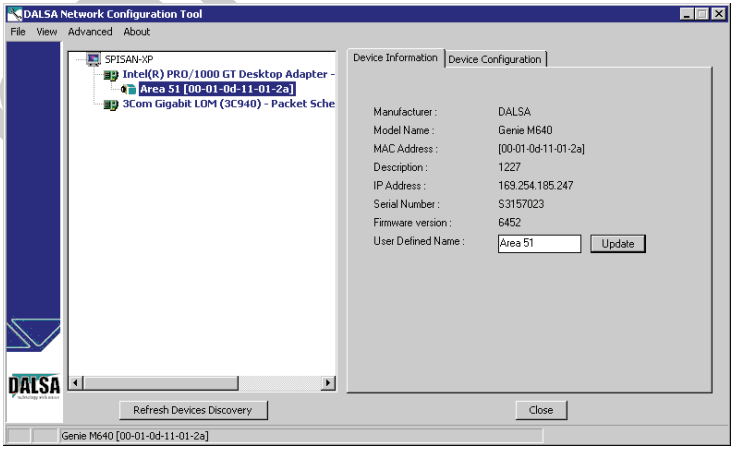
The Network Configuration tool provides information on all network adapters installed in the system and any connected GigE Vision devices. For the Genie, the tool allows a simple method to assign a User-Defined name and also to set a Persistent IP address instead of the default DHCP/LLA assigned IP address. Using this tool, Genie network configurations can be easily made without having to use any Windows Control Panel application.

Important: Any changes made with this tool will update the Genie flash memory. Do not remove power from the Genie camera for a minimum 10 seconds. Then cycle the Genie power to load the new flash settings.

To aid technical support, the tool can save a network configuration report. From the *File* menu select "*Save current status*". You will be prompted for a filename for the report text file.

Quick Genie Network Configuration

- Start the Network Configuration program from the windows start menu: **Start•Programs•DALSA•Network Interface•DALSA Network Configuration Tool**.
- The left display window will show all installed network adapters and any connected Genie camera.
- Click on a Genie camera to see information such as MAC address, current IP address, serial and firmware numbers.
- Click in the User Defined Name edit box and change the Genie name as required. Click on the Update button to write into the Genie memory.



Genie Network Information

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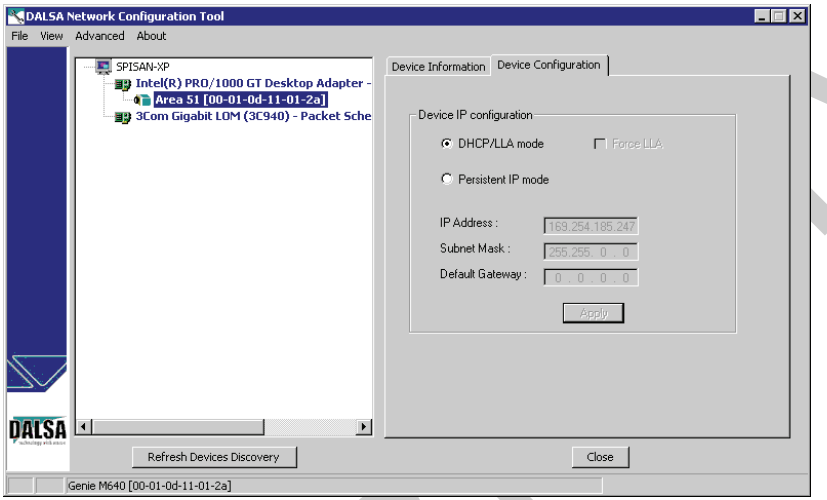
- Select the **Device Configuration tab** to switch from the default IP configuration mode DHCP/LLA to Persistent IP mode (only if required).
- With Persistent IP mode selected enter the desired IP address, subnet mask, and default gateway. Important: do not forget the persistent IP address you assign, else the camera can not be controlled.



Genie IP Configuration

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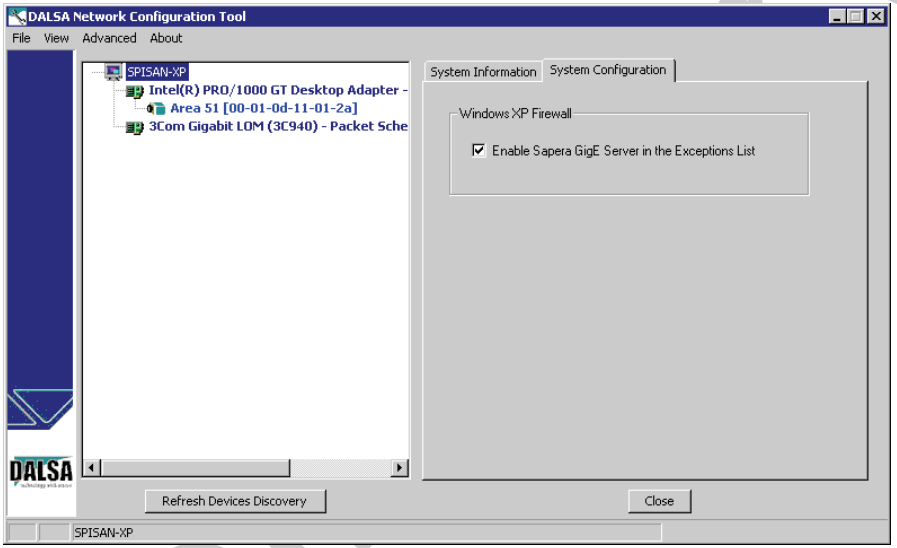
System Information and Configuration

Select the system icon (the computer symbol) in the left pane to display current system information which may be required when documenting Genie installations. There are no user changeable fields in the System Information tab.

In the right hand pane click on the **System Configuration tab**. By default the Sapera GigE Server is added to the Windows Firewall exception list. This function is performed automatically when the Genie software package is installed. This ensures the Windows Firewall remains active (if it was enabled) without having to individually put each Genie application program in the exception list.



System Firewall Configuration

If the computer is using a different firewall software package, refer to that firewall's software manual to allow the Sapera GigE Server to have access through it.

Alternatively, it is possible to exclude a specified NIC from using the firewall. A NIC dedicated to the Genie camera does not need Windows firewall. See "Disabling Windows Firewall" on page 103 for details on excluding a NIC from firewall settings.

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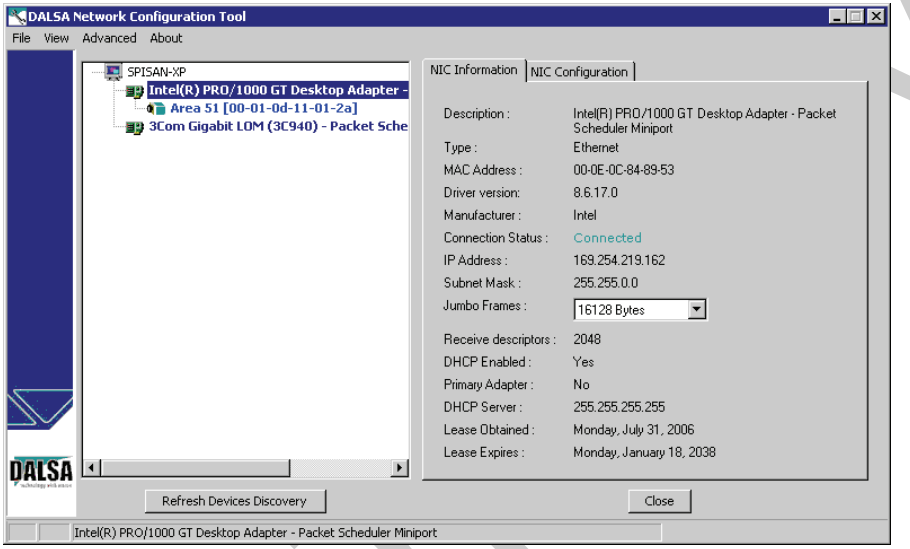
Network Card Information and Configuration

Select a network card icon in the left pane to see the NIC configuration parameters. The Network Configuration tool ensures that no two NIC devices installed in the computer are on the same subnet, since that would create a conflict. A warning message is displayed in such a case, indicating that a settings change is required for one of the NIC.


DALSA Network Configuration Tool
File View Advanced About
SPISAN-XP
Intel(R) PRO/1000 GT Desktop Adapter -
Area 51 [00-01-0d-11-01-2a]
3Com Gigabit LOM (3C940) - Packet Sche
NIC Information
NIC Configuration
Description : Intel(R) PRO/1000 GT Desktop Adapter - Packet Scheduler Miniport
Type : Ethernet
MAC Address : 00-0E-0C-84-89-53
Driver version: 8.6.17.0
Manufacturer : Intel
Connection Status : Connected
IP Address : 169.254.219.162
Subnet Mask : 255.255.0.0
Jumbo Frames : 16128 Bytes
Receive descriptors : 2048
DHCP Enabled : Yes
Primary Adapter : No
DHCP Server : 255.255.255.255
Lease Obtained : Monday, July 31, 2006
Lease Expires : Monday, January 18, 2038
DALSA
Refresh Devices Discovery
Close
Intel(R) PRO/1000 GT Desktop Adapter - Packet Scheduler Miniport

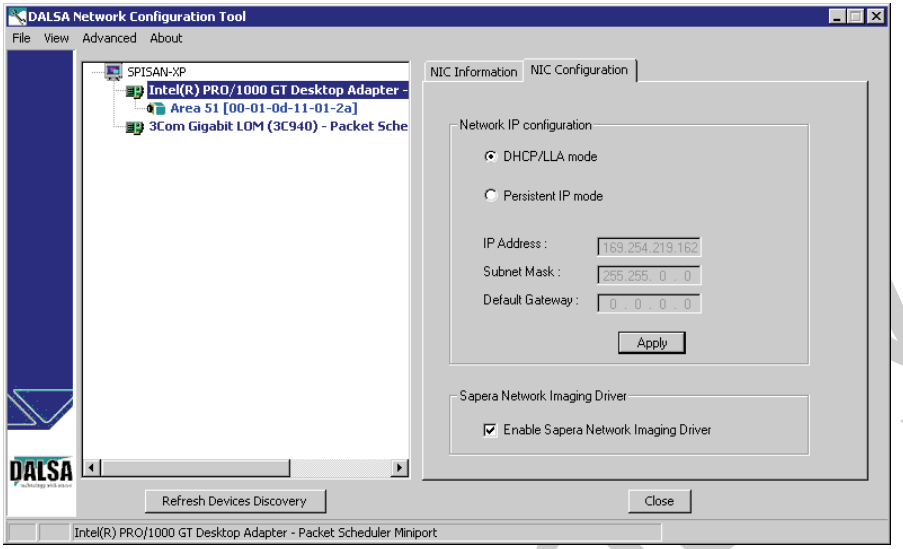
NIC Information

NIC IP and Network Imaging Driver Assignment

For each NIC, it is possible to configure the IP configuration mode (either DHCP/LLA or Persistent IP) if required via the NIC Configuration tab.

Warning: Changing the NIC IP address may put it on a different subnet than the Genie. Changing the NIC IP configuration first might cause the case where the camera becomes inaccessible from the NIC. The proper sequence is to first change the camera IP configuration then change the NIC IP.

Preliminary



After installation, all system NIC devices have the Sapera Network Imaging driver enabled. Only the NIC connected to a Genie camera requires the Network Imaging driver enabled to capture images from Genie. The Network Imaging driver streams image data efficiently to image buffers.

Select other NIC devices in the system and disable the Network Imaging Driver if they are not used with a Genie camera.

Recovering a Camera with an Unknown Persistent IP

When a Genie camera has been configured with a persistent IP address, that camera can not be controlled if the persistent IP address has been lost or forgotten. The DALSA Network Configuration tool provides a function to recover cameras and reset them back to the DHCP/LLA mode. The camera can also be set to a new persistent IP address immediately if required.

Important: To recover a Genie camera, the camera MAC address must be known. DALSA ships all Genie cameras with a label stating its serial number and MAC address. Additionally the NIC connected to the Genie must be configured for LLA mode.

To recover a Genie:

- Start the Network Configuration program from the windows start menu: **Start•Programs•DALSA•Network Interface•DALSA Network Configuration Tool**.
- From the menu bar click on **Advanced** and then on **Recover Camera**.
- On the dialog enter the camera MAC address and click the Recover Camera button.

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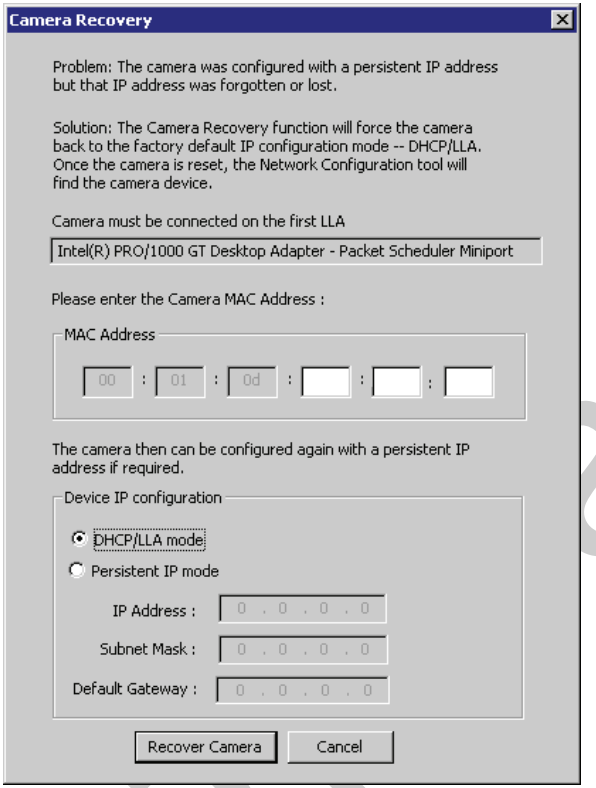
Camera Recovery
Problem: The camera was configured with a persistent IP address but that IP address was forgotten or lost.
Solution: The Camera Recovery function will force the camera back to the factory default IP configuration mode -- DHCP/LLA. Once the camera is reset, the Network Configuration tool will find the camera device.
Camera must be connected on the first LLA
Intel(R) PRO/1000 GT Desktop Adapter - Packet Scheduler Miniport
Please enter the Camera MAC Address :
MAC Address
00 : 01 : 0d : : : :
The camera then can be configured again with a persistent IP address if required.
Device IP configuration
DHCP/LLA mode
Persistent IP mode
IP Address : 0 . 0 . 0 . 0
Subnet Mask : 0 . 0 . 0 . 0
Default Gateway : 0 . 0 . 0 . 0
Recover Camera
Cancel

- If the camera requires a persistent IP address, select the bullet to assign a persistent IP immediately with recovery. Enter the new IP address and click on Recover Camera.

Important: Any changes made with this tool will update the Genie flash memory. Do not remove power from the Genie camera for a minimum 10 seconds. Then cycle the Genie power to load the new flash settings.

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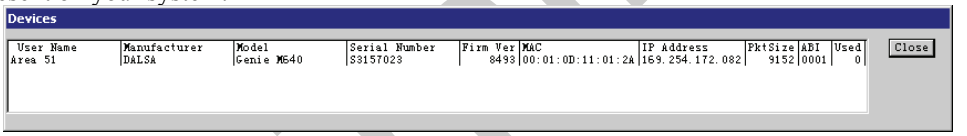
Sapera GigE Server Details

This section provides additional details on the GigE Server not covered in the Genie installation section of this manual. Generally the Genie automatic installation requires no user intervention.

- The Sapera GigE Server implements the GigE Vision Control Protocol (GVCP). This provides the interface to generate GVCP messages to control and configure a GigE Vision device.
- GigE Server handles the heartbeat messages, allowing an application in development, to be single-stepped while in debug mode, without loss of the camera connection.
- GigE Server is a single application going through the firewall. This simplifies firewall settings as only this application needs to be listed in the firewall exceptions.
- The GigE Server periodically rescans the network to discover any new camera that might have been added to the network. This will also identify devices removed.
- When required, it is possible to disabled the GigE server. A Sapera application will then directly be linked to the library responsible for GigE Vision control channel communications. This can be used to minimize inter-process communications.
- The GigE Server Status window provides valuable information about the GigE Vision devices present on your system:



Status Window Description

Model	GigE Vision device model
Manufacturer	Manufacturer for this device
Device	Index of this device in the current list
Handle	Sapera handle used to control this device
PktSize	Largest packet size that should be used for image streaming. This is found using the Test Packet mechanism of GigE Vision.
MAC	Device MAC address
Used	Indicates if an application is linked to this device. Only one application is allowed to control a device.
IP Address	Device IP address
ABI	Sapera Application Binary Interface to communicate with the device

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Preliminary

Sapera CamExpert Guide

Using CamExpert with Genie Monochrome Cameras

CamExpert is the camera interfacing tool supported by the Sapera library. When used with a Genie camera, CamExpert allows a user to test all Genie operating modes. Additionally CamExpert saves the Genie user settings configuration to the camera or saves multiple configurations as individual camera parameter files on the host system (*.*ccf*).

An important component of CamExpert is its live acquisition display window which allows immediate verification of timing or control parameters without the need to run a separate acquisition program.

For context sensitive help, click on the button then click on a camera configuration parameter. A short description of the configuration parameter will be shown in a popup. Click on the button to open the help file for more descriptive information on CamExpert.

The central section of CamExpert provides access to the Genie parameters. Five tabs group Genie parameters depending on their type as described in the summary below. Each Genie configuration parameter is described in detail following the summary.

Camera Information	Displays Genie firmware details such as camera model, version, serial number and MAC address. Users can set the User ID and set the power-up configuration mode.
Sensor Parameters	Displays both static and variable sensor parameters that are Genie model specific. Variable parameters control Genie exposure, binning, gain and exposure controls. The internal test image is selected here.
I/O Controls	Provides controls for trigger source and I/O pin configuration.
Image Buffer and ROI	Provides controls for buffer pixel depth, image size and cropping.
GigE Vision	Provides advance controls to optimize the network connection.

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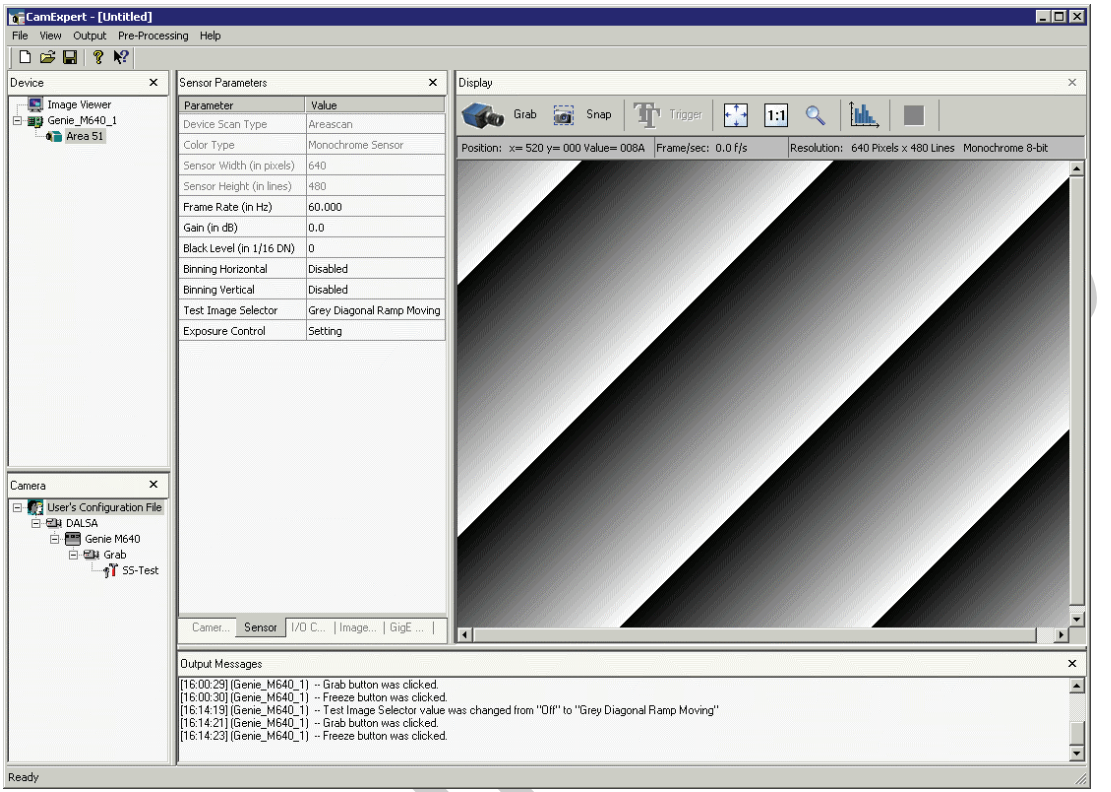
CamExpert Panes



The CamExpert application uses 5 windows to simplify choosing and configuring camera files or acquisition parameters for the installed device.

- Device pane: View and select from any installed Sapera acquisition device. Once a device is selected CamExpert will only present acquisition parameters applicable to that device.
- Parameters pane: Allows viewing or changing all acquisition parameters supported by the acquisition device. CamExpert displays parameters only if those parameters are supported by the installed device. This avoids confusion by eliminating parameter choices when they do not apply to the hardware in use.
- Display pane: Provides a live or single frame acquisition display. Frame buffer parameters are shown in an information bar above the image window.
- Camera pane: Allows selecting any camera file that is included with the Sapera installation. Only camera files supported by the selected acquisition device. When there is more then one acquisition server, such as monochrome and RGB, selecting an inappropriate camera file will produce a message prompting you to select the correct acquisition server.

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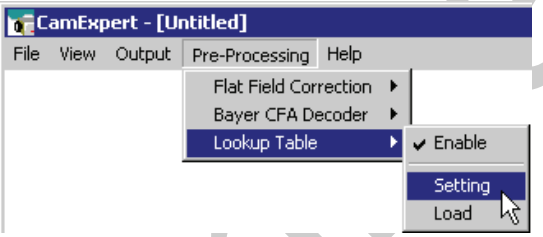
- Output pane: Displays messages from CamExpert or the device driver.
- Video Status bar: Located on the lower right of the CamExpert window, color coded camera signal status information is displayed. Green for valid signals detected, red for missing or incorrect signals. Video status items may differ with different devices.

Most of these panes can be hidden via the menu bar view command. Typically after selecting an acquisition device and loading a camera file, the Device and Camera windows can be closed.

CamExpert LUT Controls

The Lookup Table dialog allows you to configure the LUT if it is available on the device. Genie monochrome cameras support an 8-bit LUT. To open this dialog, use the Pre-Processing > Lookup Table > Setting menu command. Note that you must first enable the Lookup Table, otherwise the Setting command will be grayed-out.



To select the type of LUT to use, click the LUT Mode Value field; a drop-down list box displays the available modes. The Lookup Table dialog displays a graph of the input and output values for the selected LUT. These are CamExpert common examples for LUT operations. A Sapera application can program the Genie LUT for any required LUT operation. See "Lookup Table (LUT)" on page 56 for Genie LUT support.

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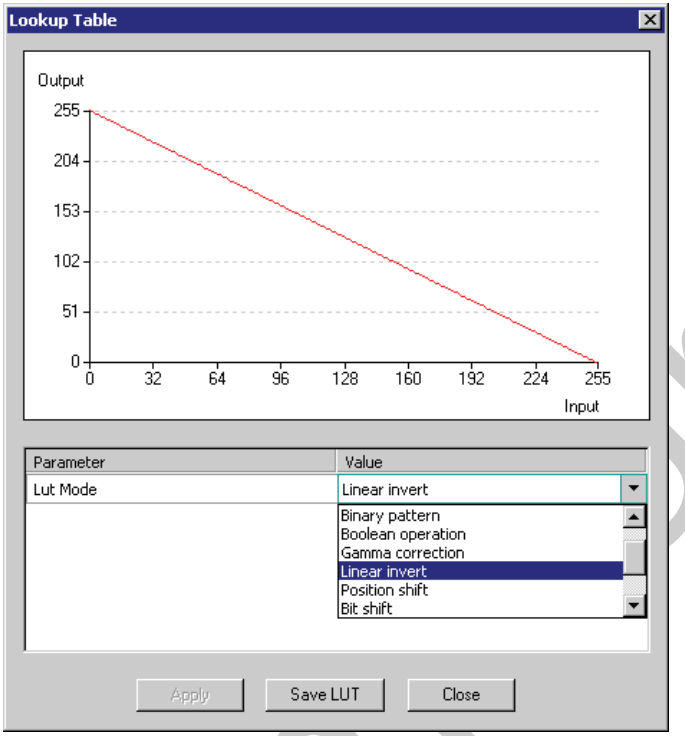

CamExpert available LUT examples are briefly described below. The LUT function graphic simplifies understanding the operation especially when user settings modify the LUT function.

- Normal (default): modifies all LUT entries using a linear mapping such that a gray level input is equal to the output
- Arithmetic operation: modifies all LUT entries using an arithmetic operation
- Binary pattern: modifies some LUT entries based on a binary pattern
- Boolean operation: modifies all LUT entries using a Boolean operation
- Gamma correction: modifies all LUT entries using Gamma correction function
- Linear invert: modifies all LUT entries using a linear mapping with a negative slope
- Position shift: modifies LUT entries with a zero position offset
- Bit shift: modifies LUT entries with a binary bit shift
- Slope within range: modifies part of a LUT with a linear mapping
- Single Threshold: modifies all LUT entries using a threshold operation
- Double Threshold: modifies all LUT entries using a dual level threshold operation

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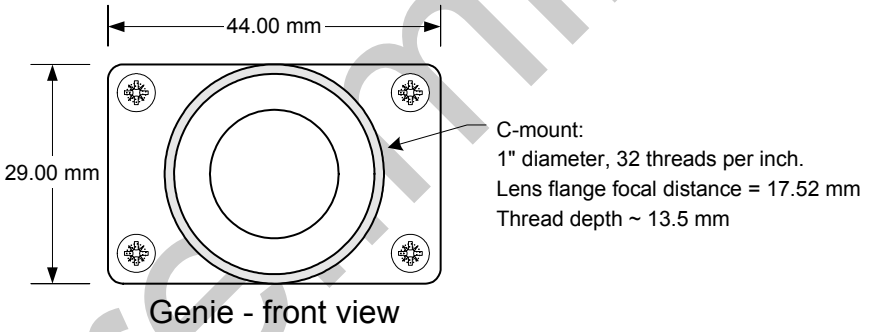
Technical Specifications

Mechanical Specifications

- For information on Genie connectors see "Rear View – Connectors" on page 90.
- For information on Genie lens requirements see "Front View – Lens Mount" on page 89 and "Optical Considerations" on page 95.
- For information on Genie case mounting dimensions see "Bottom View – Camera Mounting" on page 89.

Front View – Lens Mount

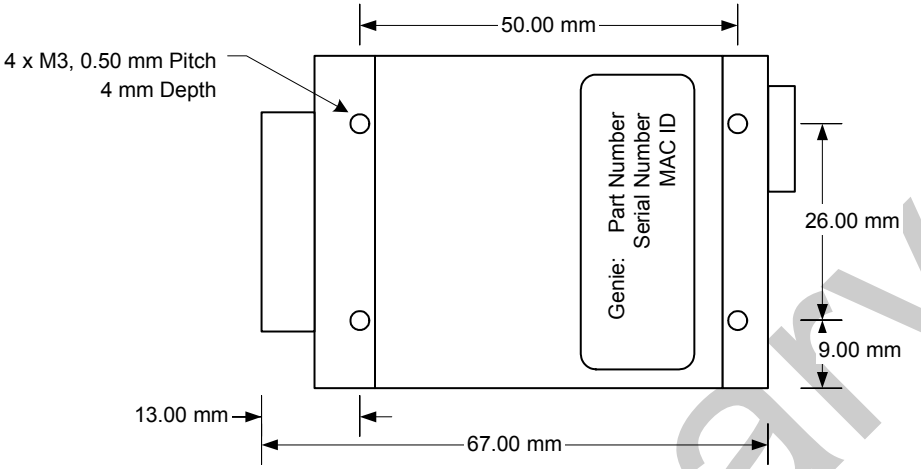
The following figure shows lens mount view and associated dimensions. See section "Optical Considerations" on page 95 for information to choosing a lens for the Genie camera.



Bottom View – Camera Mounting

The following figure shows the location of the four mounting screw holes and the overall camera length (without the Hirose 12-pin connector).

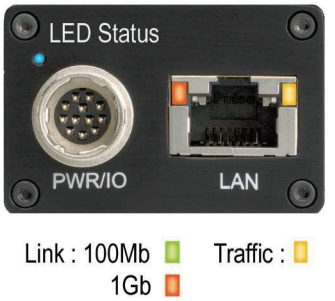
Preliminary



Note: The camera top also has four mounting holes in identical locations.

Rear View – Connectors

The following figure of the Genie back end shows connector and led locations. Technical details follow below the figure. An industrial case version supports a screw lock Ethernet cable (see "Industrial RJ45 Ethernet Cables" on page 99).



LED Status	
Solid	IP Address Assigned
Slow	Waiting for an IP Address
Fast	Ethernet Cable Disconnected
Solid	Application Linked to the Camera
Slow	Trigger Acquisition in Progress
Fast	Acquisition in Progress
Slow	Camera Initialization Problem
Fast	Camera Overheating

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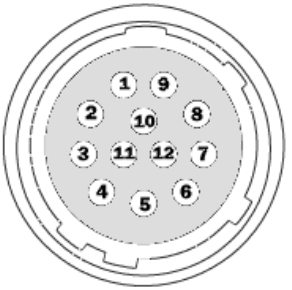
Connectors

- A single **RJ45 Ethernet** connector for control and video data to the host Gigabit NIC. Genie is available with an industrial case supporting a screw lock Ethernet cable (see "Industrial RJ45 Ethernet Cables" on page 99).
- A single **12-pin Hirose** male connector for power, trigger and strobe signals. The suggested female cable mating connector is Hirose model HR10A-10P-12S.

12-Pin Hirose Connector Signal Details

The following figure shows the pinout identification when looking at the Genie camera 12-pin male Hirose connector. The table below the figure lists the Genie I/O signal specifications.



Pin	Direction	Genie Signal (see details below)	Notes
1	-	Power GND	
2	-	+12V DC power supply	10% tolerance
3	Out	Output 1 -	
4	Out	Output 1 +	
5	In	Input 1 -	RS422- or TTL GND
6	In	Input 1 +	RS422+ or TTL
7	Out	Output 2 + / Strobe +	
8	Out	Output 2 - / Strobe -	
9	-	Reserved	
10	-	Reserved	
11	In	Input 2 + / Trigger +	RS422+ or TTL
12	In	Input 2 - / Trigger -	RS422- or TTL GND
shell / shield	via cable shield	Genie chassis connects to supply earth ground	improves EMI shielding

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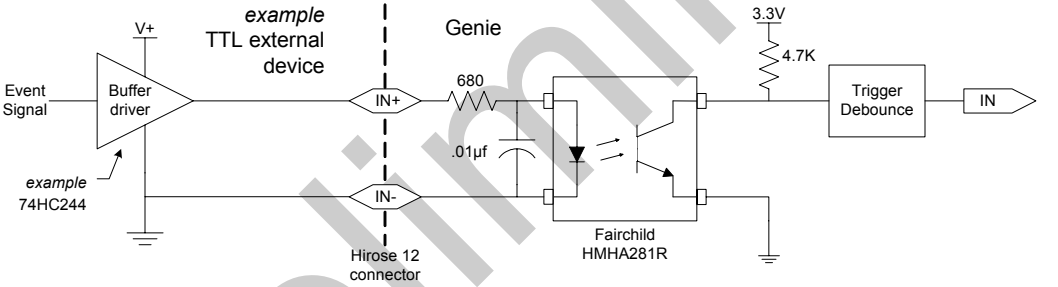
Genie Signal Electrical Details

- **Power Supply (pin 2)**: +12V DC nominal.
  Operating tolerance +10% to –10%.
  Over voltage and reverse voltage protection circuit built in. The protection circuit is reset by shutting down or disconnecting the power supply.
- The **12-pin Hirose** male connector shell and cable shield should connect to the supply earth ground to improve EMI shielding.

External Inputs

- Opto-coupled (2V to 12V, 2mA minimum) with internal current limit.
- RS422 or TTL signal type.
- Used as trigger or integration control.
- External signal polarity selected via configuration parameter.
- User programmable debounce time from 1 to 255µs.
- See "Input Controls via Sapera LT or GenICam Applications" on page 50.



External Input Detail with an Example Signal Driver

The opto-coupler is typically a Fairchild HMHA281 with the following characteristics.

Input Electrical Parameter Description	Value
Voltage threshold to turn OFF	0.8 V
Voltage threshold to turn ON	2 V
Minimum input current to turn ON	2 mA
Maximum input current	50 mA
Minimum input pulse width to turn ON	30 us
Maximum input voltage	13 V

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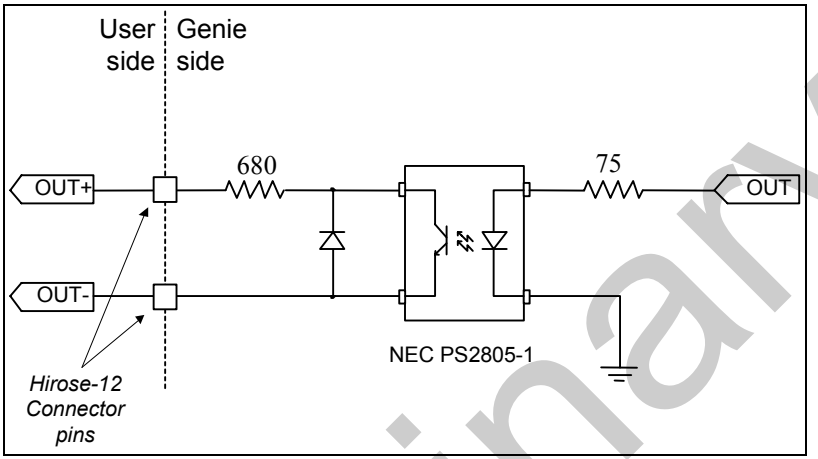
External Outputs

- Programmable output mode such as strobe, event notification, etc. (see "Output Control via Sapera LT or GenICam Applications" on page 56).



The opto-coupler is typically a NEC PS2805-1 with the following characteristics.

Output Electrical Parameter Description	Value
Maximum voltage difference	13 V
Maximum current through opto-coupler	12mA
Minimum output pulse width	100 us
Maximum switch closure transition time	12 µs
Maximum switch open transition time	40 µs

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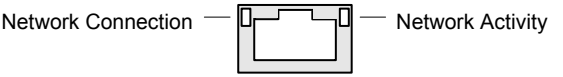
RJ45 LAN Ethernet Connector Details

The RJ45 LAN connector has two LEDs for network status conditions.

The LED color codes are as follows.

Network Connection		Network Activity	
Green	100Mbps	Off	no network activity
Orange	1000Mbps	Yellow	typically blinking – active



The Genie LAN connector is a standard Ethernet socket. Use CAT5e or CAT6 certified Ethernet cables. CAT5e cable is rated for 100 MHz spectral bandwidth but CAT6 cable is rated for a 200 MHz spectral bandwidth with less signal attenuation, therefore strongly recommended for long connection lengths.

The interconnection Ethernet cable can be either Straight Through or Crossover cable type. The Gigabit Ethernet standard for devices defines that they will auto-negotiate send and receive channels, eliminating the need for users to use a specific Ethernet cable type.

Camera Status LED

The Genie has one multicolor LED to provide a simple visible indication of the operational status of the camera. When more than one condition is active, the LED color indicates the condition with the highest priority. The following table summarizes the LED states and corresponding camera status.

LED State	Definition
LED is off	No power to the camera
Steady Red	Camera not initialized
Slow Flashing Red	Camera initialization problem
Fast Flashing Red	Camera is too hot
Slow Flashing Blue	Waiting for an IP address
Fast Flashing Blue	Ethernet cable disconnected (no link)
Steady Blue	IP address assigned; no application connected to the camera
Steady Green	Application connected
Slow Flashing Green	Triggered acquisition in progress
Fast Flashing Green	Free running acquisition in progress

Preliminary

Optical Considerations

This section provides an overview to illumination, light sources, filters, lens modeling, and lens magnification. Each of these components contribute to the successful design of an imaging solution.

Illumination

The amount and wavelengths of light required to capture useful images depend on the particular application. Factors include the nature, speed, and spectral characteristics of objects being imaged, exposure times, light source characteristics, environmental and acquisition system specifics, and more. The DALSA Web site, http://vfm.dalsa.com/, provides an introduction to this potentially complicated issue. Click on the **Application Support** link and then select the **CCD Technology Primer**. Review "Radiometry and Photo Responsivity" along with other sections of interest.

It is often more important to consider exposure than illumination. The total amount of energy (which is related to the total number of photons reaching the sensor) is more important than the rate at which it arrives. For example, $5\mu J/cm^2$ can be achieved by exposing $5mW/cm^2$ for 1ms just the same as exposing an intensity of $5W/cm^2$ for 1µs.

Light Sources

Keep these guidelines in mind when selecting and setting up light source:

- LED light sources are relatively inexpensive, provide a uniform field, and longer life span compared to other light sources. However, they also require a camera with excellent sensitivity.
- Halogen light sources generally provide very little blue relative to infrared light (IR).
- Fiber-optic light distribution systems generally transmit very little blue relative to IR.
- Some light sources age such that over their life span they produce less light. This aging may not be uniform—a light source may produce progressively less light in some areas of the spectrum but not others.

Filters

CCD cameras are extremely responsive to infrared (IR) wavelengths of light. To prevent infrared from distorting the images you scan, use a "hot mirror" or IR cutoff filter that transmits visible wavelengths but does not transmit wavelengths over 750nm. Examples are the Schneider Optics™ B+W 489, which includes a mounting ring, the CORION™ LS-750, which does not include a mounting ring, and the CORION™ HR-750 series hot mirror.

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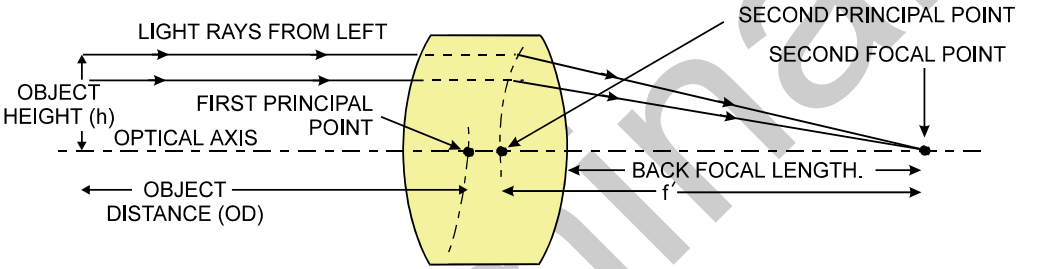
Lens Modeling

Any lens surrounded by air can be modeled for camera purposes using three primary points: the first and second principal points and the second focal point. The primary points for a lens should be available from the lens data sheet or from the lens manufacturer. Primed quantities denote characteristics of the image side of the lens. That is, *h* is the object height and *h′* is the image height.

The *focal point* is the point at which the image of an infinitely distant object is brought to focus. The *effective focal length (f′)* is the distance from the second principal point to the second focal point. The *back focal length (BFL)* is the distance from the image side of the lens surface to the second focal point. The *object distance (OD)* is the distance from the first principal point to the object.

Primary Points in a Lens System



Magnification and Resolution

The magnification of a lens is the ratio of the image size to the object size:

$m = \frac{h'}{h}$	Where m is the magnification, h' is the image height (pixel size) and h is the object height (desired object resolution size).

By similar triangles, the magnification is alternatively given by:

$m = \frac{f'}{OD}$

These equations can be combined to give their most useful form:

$\frac{h'}{h} = \frac{f'}{OD}$	This is the governing equation for many object and image plane parameters.

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Example: An acquisition system has a 512 x 512 element, 10µm pixel pitch area scan camera, a lens with an effective focal length of 45mm, and requires that 100µm in the object space correspond to each pixel in the image sensor. Using the preceding equation, the object distance must be 450mm (0.450m).

$\frac{10\mu m}{100\mu m} = \frac{45mm}{OD}$	$OD = 450mm(0.450m)$

Sensor Handling Instructions

This section reviews proper procedures for handling, cleaning, or storing the Genie camera. Specifically the Genie CCD sensor needs to be kept clean and away from static discharge to maintain design performance.

Electrostatic Discharge and the CCD Sensor

Cameras contain charge-coupled device (CCD) image sensors, which are metal oxide semiconductor (MOS) devices and are susceptible to damage from electrostatic discharge (ESD).

Electrostatic charge introduced to the sensor window surface can induce charge buildup on the underside of the window that cannot be readily dissipated by the dry nitrogen gas in the sensor package cavity. When charge buildup occurs, surface-gated photodiodes (SGPDs) may exhibit higher image lag or a highly non-uniform response, with some pixels displaying a much higher response when the sensor is exposed to uniform illumination. The charge normally dissipates within 24 hours and the sensor returns to normal operation.

Important: Charge buildup will affect the camera's flat-field correction calibration. To avoid an erroneous calibration, ensure that you perform flat-field correction only after a charge buildup has dissipated over 24 hours.

Protecting Against Dust, Oil and Scratches

The CCD window is part of the optical path and should be handled like other optical components, with extreme care.

Dust can obscure pixels, producing dark patches on the sensor response. Dust is most visible when the illumination is collimated. The dark patches shift position as the angle of illumination changes. Dust is normally not visible when the sensor is positioned at the exit port of an integrating sphere, where the illumination is diffuse.

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Dust can normally be removed by blowing the window surface using a compressed air blower, unless the dust particles are being held by an electrostatic charge, in which case either an ionized air blower or wet cleaning is necessary.

Oil is usually introduced during handling. Touching the surface of the window barehanded will leave oily residues. Using rubber finger cots and rubber gloves can prevent oil contamination. However, the friction between the rubber and the window may produce electrostatic charge that may damage the sensor.

Scratches can be caused by improper handling, cleaning or storage of the camera. When handling or storing the Genie camera without a lens, always install the C-mount protective cap. Scratches diffract incident illumination. When exposed to uniform illumination, a sensor with a scratched window will normally have brighter pixels adjacent to darker pixels. The location of these pixels changes with the angle of illumination.

Cleaning the Sensor Window

Even with careful handling, the sensor window may need cleaning. The following steps describe various cleaning techniques to clean minor dust particles to accidental finger touches.

- Use compressed air to blow off loose particles. This step alone is usually sufficient to clean the sensor window. Avoid moving or shaking the compressed air container and use short bursts of air while moving the camera in the air stream. Agitating the container will cause condensation to form in the air stream. Long air bursts will chill the sensor window causing more condensation. Condensation, even when left to dry naturally, will deposit more particles on the sensor.
- When compressed air cannot clean the sensor, Dalsa recommends using lint-free ESD-safe cloth wipers that do not contain particles that can scratch the window. The Anticon Gold 9”x 9” wiper made by Milliken is both ESD safe and suitable for class 100 environments. Another ESD acceptable wiper is the TX4025 from Texwipe.
- An alternative to ESD-safe cloth wipers is Transplex swabs that have desirable ESD properties. There are several varieties available from Texwipe. Do not use regular cotton swabs, since these can introduce static charge to the window surface.
- Wipe the window carefully and slowly when using these products.

Environment

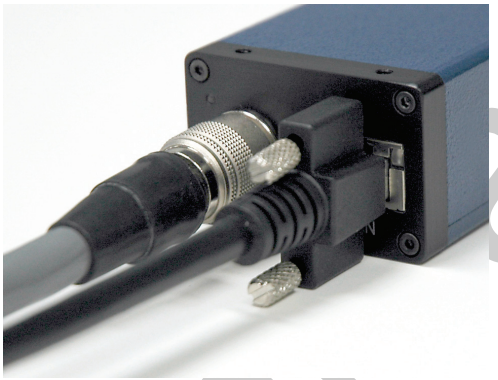
Ambient Temperature:	10° to 45° C (operation) 0° to 70° C (storage)
Relative Humidity:	5% to 90% non-condensing (operating) 0% to 95% (storage)

Preliminary

Industrial RJ45 Ethernet Cables

Components Express Inc. has available an industrial RJ45 CAT6 cable that on one end has a molded shroud assembly with top/bottom thumbscrews, while the other end has a standard RJ45. This cable is recommended when Genie is installed in a high vibration environment.

Contact sales at DALSA for availability of Genie with female mounts for this secure Ethernet cable.



Components Express, Inc. (CEI)
10330 Argonne Woods Drive, Suite 100
Woodridge, IL 60517-4995
Phone: 630-257-0605 / 800.578.6695 (outside Illinois)
Fax: 630-257-0603
http://www.componentsexpress.com/

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IGE-3M (3meters)
IGE-10M (10meters)
IGE-25M (25meters)
IGE-50M (50meters)
IGE-100M (100meters)

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Computer Requirements for Genie Series Cameras

The following information is a guide to computer and networking equipment required to support the Genie camera at maximum performance. The Genie camera series complies with the current IPv4 Internet Protocol, therefore current Gigabit Ethernet (GigE) equipment should provide trouble free performance.

Host PC System

- Pentium 4 system (or AMD equivalent) with 512 MB system memory.
- System motherboard without an embedded graphic card. Avoid using onboard video cards as they may compete with other components for shared memory.
- High performance video card as either an AGP bus or PCI Express bus.
- GigE network adapter (either PCI card or on motherboard). The Intel PRO/1000 MT adapter is an example of a high performance NIC. Typically a system will need an Ethernet GigE PCI adapter to supplement the single NIC on the motherboard.
- Operating System: Windows 2000 SP1 and Windows XP are supported.

Ethernet Switch Requirements

When there is more than one device on the same network or a camera-to-PC separation greater than 100 meters, an Ethernet switch is required. Since the Genie GigE camera complies with the Internet Protocol, it should work with all standard Ethernet switches. However, switches offer a range of functions and performance grades, so care must be taken to choose the right switch for a particular application. The following switches are expected to work with the camera:

- SMC (http://www.smc.com/) TigerSwitch 86xxT family
  Features: Layer 2 with IGMP v2.0 that supports jumbo frames and multicast.
- 3COM (http://www.3com.com/) 3C1740x (3800 Family):
  Features: Layer 2 with IGMP v2.0 that supports multicast.
- Dlink (http://www.dlink.com/) DGS-10xxTx 10/100/1000 family:
  Features: Layer 2 unmanaged switch that converts multicast into a broadcast.
- 3COM (http://www.3com.com/) 3C1770x (4900 Family):
  Features: Layer 2 non-blocking switch that converts multicast into a broadcast.
- Dlink (http://www.dlink.com/) DGS-3308FG & DGS-3308-TG
  Features: Layer 3 non-blocking switch that supports multicast.
- Cisco (http://www.cisco.com/) WS-C3750G-12S-S:
  Features: Layer 3 switch that supports multicast.

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Ethernet to Fiber-Optic Interface Requirements

In cases of camera-to-PC separations of more than 100 meters but an Ethernet switch is not desired, a fiber-optic media converter can be used. The FlexPoint GX from Omnitron Systems (http://www.omnitron-systems.com/) converts GigE to fiber transmission and vice versa. It supports multimode (MM) fiber over distances of up to 220 m (720 ft.) and single-mode (SM) fiber up to 65 km (40 mi.) with SC, MT-RJ, or LC connector types.

Important: The inclusion in this manual of GigE to fiber-optic converters does not guarantee they will meet specific application requirements or performance. The user must evaluate any supplemental Ethernet equipment.

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Troubleshooting

Overview

In rare cases an installation may fail or there are problems in controlling and using the Genie camera. This section highlights issues or conditions which may cause installation problems.

Installation Issues

This section considers issues with network parameters and Windows Firewall.

Verifying Network Parameters

DALSA provides the Network Configuration tool to verify and configure network devices and the Genie network parameters. See section "Network Configuration Tool" on page 77 if there were any problems with the automatic Genie software installation.

Disabling Windows Firewall

Connecting the Genie camera to a system running a firewall would require careful planning of the camera IP and the ports used by the streaming video and messaging. In general, the Genie camera is installed in a private network or within a corporate network with an external firewall. In both these cases, the host system that the Genie connects to does not need to run a firewall, therefore eliminating installation issues.

The Network Configuration tool automatically adds the Sapera GigE Server in the list of Exceptions of the Windows firewall. Therefore, in most situations, you don't have to take any special precaution to have the Genie run through the firewall.

The following figure shows how to turn off the Windows XP firewall when the computer is behind a corporate network firewall. Run the Windows firewall application from the start menu **Start ● Settings ● Control Panel ● Windows Firewall**. If the host computer is running a firewall from a third party, review the program's documentation to disable its execution.

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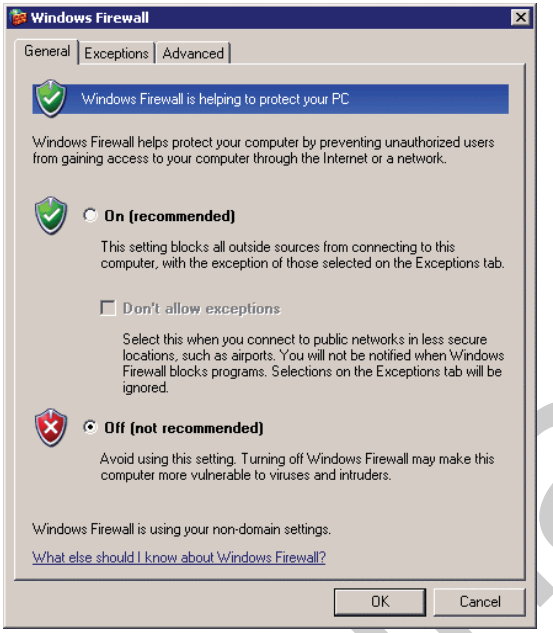
Windows Firewall
General
Exceptions
Advanced
Windows Firewall is helping to protect your PC
Windows Firewall helps protect your computer by preventing unauthorized users from gaining access to your computer through the Internet or a network.
On (recommended)
This setting blocks all outside sources from connecting to this computer, with the exception of those selected on the Exceptions tab.
Don't allow exceptions
Select this when you connect to public networks in less secure locations, such as airports. You will not be notified when Windows Firewall blocks programs. Selections on the Exceptions tab will be ignored.
Off (not recommended)
Avoid using this setting. Turning off Windows Firewall may make this computer more vulnerable to viruses and intruders.
Windows Firewall is using your non-domain settings.
What else should I know about Windows Firewall?
OK
Cancel

Turning Windows Firewall Off

With a computer that is not behind a corporate firewall an alternative is to disable Windows firewall only for the network adapter dedicated for the Genie camera. Such a computer would have two or more network adapters where one NIC only connects to the Genie—never the Internet.

The following figures show an example of the Windows firewall On but disabled for the network adapter used by Genie.

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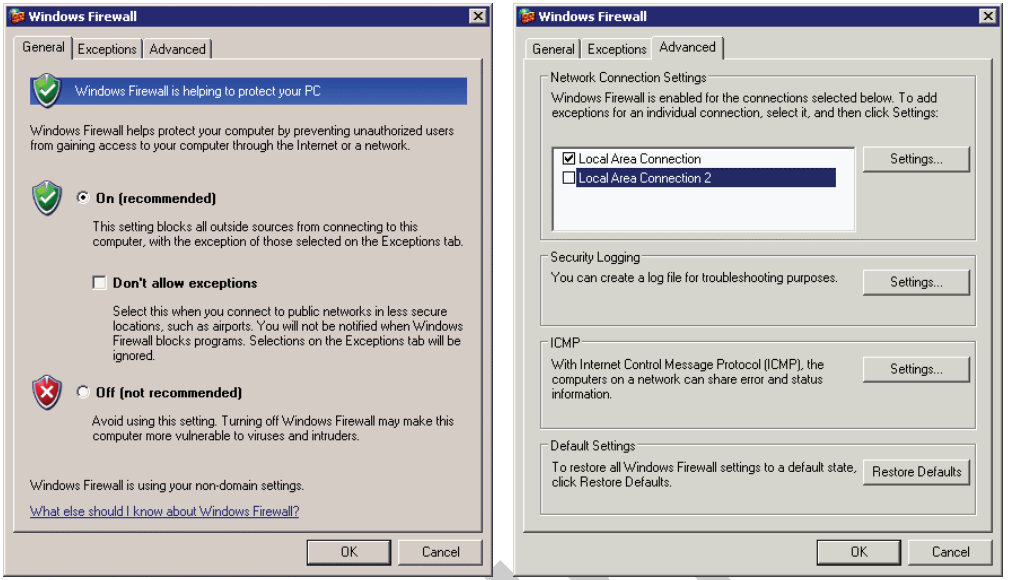
Windows Firewall
General
Exceptions
Advanced
Windows Firewall is helping to protect your PC
Windows Firewall helps protect your computer by preventing unauthorized users from gaining access to your computer through the Internet or a network.
On (recommended)
This setting blocks all outside sources from connecting to this computer, with the exception of those selected on the Exceptions tab.
Don't allow exceptions
Select this when you connect to public networks in less secure locations, such as airports. You will not be notified when Windows Firewall blocks programs. Selections on the Exceptions tab will be ignored.
Off (not recommended)
Avoid using this setting. Turning off Windows Firewall may make this computer more vulnerable to viruses and intruders.
Windows Firewall is using your non-domain settings.
What else should I know about Windows Firewall?
OK
Cancel
Windows Firewall
General
Exceptions
Advanced
Network Connection Settings
Windows Firewall is enabled for the connections selected below. To add exceptions for an individual connection, select it, and then click Settings:
Local Area Connection
Local Area Connection 2
Settings...
Security Logging
You can create a log file for troubleshooting purposes.
Settings...
ICMP
With Internet Control Message Protocol (ICMP), the computers on a network can share error and status information.
Settings...
Default Settings
To restore all Windows Firewall settings to a default state, click Restore Defaults.
Restore Defaults
OK
Cancel

Windows Firewall Off for Genie Only

Operational Issues

This section considers issues with cabling, Ethernet switches, multiple cameras, and camera exposure.

Cabling and IP Configuration Issues

With only two cables connected to Genie, possible cabling issues are limited.

Power supply problems:

- If the Genie status LED is off, the DC supply power is not connected or faulty. Verify the power supply voltage at the Hirose connector. See "12-Pin Hirose Connector Signal Details" on page 91 for pinout information.

Communication problems:

- Use a shielded cable where the Hirose connector shell electrically connects the Genie chassis to the power supply earth ground. This can eliminate issues in a high EMI environment.
- Check that the Ethernet cable is clipped both to the Genie and the NIC or switch on the other end.
- Use a secured Ethernet cable when the Genie is in a high vibration environment. See "Industrial RJ45 Ethernet Cables" on page 99.

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- Check the Ethernet status LEDs on the Genie RJ45 connector. The network speed indicator should show the expect connection speed and the activity LED should flash with network messages.
- Verify that the Ethernet cable is CAT5e or CAT6.
- See "RJ45 LAN Ethernet Connector Details" on page 94 RJ45 LAN Ethernet Connector Details for more information on the Ethernet connection status LEDs.
- The Genie camera status LED, when connected and assigned an IP address will light steady blue. See "Camera Status LED" on page 94 for details on all camera states indicated by the LED.
- When using a VLAN Ethernet switch, the Genie and controlling computer must be on the same subnet. See "Using Genie with a VLAN Ethernet Switch" on page 18.
- Run the Sapera Log Viewer: **Start•Programs•DALSA•Sapera LT•Tools•Log Viewer**. Start the Genie acquisition program, such as CamExpert. There should not be any "packet resend" messages, else this indicates a control or video transmission problem due to poor connections or extremely high EMI environments.

Streaming Video (grab) Issues

When using CamExpert to test a Genie installation, there are no obvious installation problems but when Grab is clicked in CamExpert, a grab failure occurs. The grab remains black and an Abort message is displayed.

- Typically this problem occurs when the video stream is blocked by a third-party firewall program. Configure the firewall to pass GigE Vision applications.

Ethernet Switch Issues

An Ethernet switch usually works transparently and presents no problems. Review the following list when troubleshooting switch issues.

- Is the Ethernet switch powered on.
- Are all ports used configured as active; not disabled.
- Are any ports used configured for low speed (10 or 100 Mbps) only.
- Verify the Ethernet cabling. Poor cables will cause connections to auto-configure at lower speeds.
- When using a VLAN Ethernet switch, confirm that the Genie and controlling computer are on the same VLAN group.
- When using a chain of switches, ensure that inter-switch connection speeds are the same (1000 Mbps).

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Multiple Camera Issues

- When using multiple cameras with a computer with multiple NIC ports, confirm each Genie has been assigned an IP address by checking the GigE server (see "Sapera GigE Server Details" on page 83).
- Do not use multiple NIC port configured in LLA. In this case use a DHCP server.
- When using multiple cameras connected to an VLAN Ethernet switch, confirm that all cameras are on the same subnet. See "Using Genie with a VLAN Ethernet Switch" on page 18.

Camera Exposure Issues

No camera exposure when expected.

- Verify by using the camera in free-running mode. Do not use external trigger mode when testing a camera setup.
- If using free-running mode, verify that the exposure period is set to the maximum possible for the set frame rate.
- Load factory default from the Power-up Configuration in CamExpert. This will reset the camera to its nominal acquisition rate.

Camera is functional but frame rate is lower than expected.

- Verify Ethernet link speed. If the LAN connection is limited to 100 Mbps, the monochrome Genie frame rate maximum will be around 30 fps for a 640x480 exposure. Higher resolution Genie models would have even lower frame rates without a Gigabit Ethernet connection.
- If using an external trigger, verify the trigger source rate and Genie parameters such as trigger to exposure delay.
- Verify the exposure mode type is Synchronous, not Reset mode. (See "Synchronization Timing" on page 46).

Camera is functional, frame rate is as expected, but image is black.

- Verify that the lens iris is open.
- Aim the Genie at a bright light source.
- Check that the programmed exposure duration is not too short or set it to maximum. See "Exposure Controls" on page 42.
- Using CamExpert set the Genie to output its internal pattern generator. This step is typically done for any camera installation to quickly verify the Genie and its software package.

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Genie Technical Support

Any support question or request can be submitted via our web site:

Technical support form via our web page: Support requests for imaging product installations, Support requests for imaging applications	http://www.imaging.com/support
Product literature and driver updates	http://www.imaging.com/download

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Glossary of Terms

ARP

Address Resolution Protocol provides a way to retrieve the MAC address associated to an IP address.

Bandwidth

Describes the measure of data transfer capacity.

CAT5e Ethernet cable

Category 5e was designed for transmission speeds of up to 1 gigabit per second (Gigabit Ethernet).

CAT6 Ethernet cable

Same as Category 5e, except that it is made to a higher standard. Supports transmission speeds greater than Gigabit Ethernet with less signal attenuation over a given length of cable.

CCD – Charge-Coupled Device

A type of image sensor converting light into electrical charges.

Contiguous Memory

A block of physical memory occupying consecutive addresses.

DHCP (Dynamic Host Configuration Protocol)

Protocol which provides a mechanism for allocating IP addresses dynamically by a DHCP server on a network. Typically dedicated DHCP servers are a component of corporate networks. Used for managed networks.

Driver

Also called a device driver, a program routine that links a peripheral device to the operating system. a device driver is required for its frame grabber capabilities.

DSNU

Dark Signal Non-Uniformity (equivalent to FPN).

Ethernet Switch

A network device performing bridging at full wire-speed based on MAC addresses. Packet collisions are eliminated when using a full duplex switch. An Ethernet Switch operates at Layer 2 of the seven-layer OSI model.

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FPN

Fixed Pattern Noise (equivalent to DSNU). FPN is the peak to peak difference between the minimum and maximum measured values for all active valid pixels sensor in darkness. Fixed Pattern Noise does not include a Random Noise component.

Frame

One complete image data set or its equivalent storage space.

Frame buffer

An area of memory used to hold a frame of image data. A frame buffer may exist on the acquisition hardware or be allocated by the acquisition hardware device driver in host system memory.

GigE Vision specification

Specification of the Automated Imaging Association (AIA, www.machinevisiononline.org). Defines the communication interface protocol used by any GigE Vision device.

GenICam specification

Specification of the European Machine Vision Association (EMVA, www.emva.org). Defines the capabilities of any GigE Vision device.

Grab

Acquiring an image frame.

Grayscale

In image processing, the range of available brightness levels, displayed in shades of gray. In an 8-bit system, the gray scale contains values from 0 to 255.

GVCP – GigE Vision Control Protocol

One of the core protocols of the GigE Vision specification used to control camera. GVCP uses UDP port 3956 on the camera.

GVSP – GigE Vision Stream Protocol

One of the core protocols of the GigE Vision specification used to stream images.

Host

Refers to the computer system that supports the installed frame grabber.

IP – Internet Protocol

The Internet Protocol is the method by which data is sent from one computer to another on a network or across the Internet. Each device must have an IP address to identify that device on the network or on the Internet.

LLA

Link-Local Address is a protocol providing a scheme for devices to automatically assign themselves an IP address and check for IP conflict. Used in unmanaged networks.

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NIC

Network Interface Card/Controller. For the Genie products the NIC must be a Gigabit Ethernet interface to provide sufficient bandwidth.

Pixel

A contraction of "picture element". The number of pixels describes the number of digital samples taken of the analog video signal. The number of pixels per video line by the number of active video lines describes the acquisition image resolution. The binary size of each pixel (e.g., 8-bits, 16-bits, 24-bits) defines the number of gray levels or colors possible for each pixel.

PRNU

Photo-Response Non-Uniformity. For a given even illumination the difference between the minimum and maximum measured pixel values is the PRNU.

Progressive Scan Camera

The progressive scan format outputs data from the camera (the signal) in sequential order as it is scanned. The scan format produces a full frame of video in a continuous stream, rather than half the image per output sequence in standard interlaced cameras.

Random Noise

Random noise is defined as the difference in peak to peak value for any single pixel repetitively sampled, with the sensor in darkness. For digital cameras the measurement is based on at least 512 samples from any pixel.

Router

A Router device forwards packets across networks. It operates at Layer 3 of the seven-layer OSI model. Note that broadcast packets (such as GigE Vision Device Discovery message) do not cross routers.

SAT

Saturation Output Amplitude. SAT is the average maximum output level for a specified light input.

Scatter Gather

Host system memory allocated for frame buffers is virtually contiguous but physically scattered throughout all available memory.

SNR

Signal to Noise Ratio. SNR measures the ratio between random noise and an arbitrary reference signal on the transmission path or within a device.

Subnet

The subnet is identified by performing the logical AND of the IP address with its subnet mask.

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TCP

Connection-oriented transport protocol providing robustness and reliability. Used by many Internet application, such as HTML.

Trigger

A mechanism that initiates an action when an event occurs such as synchronizing an image acquisition to an external event. A trigger generally causes a program routine to be executed such as the resetting of camera exposure and/or the firing of a strobe light.

UDP

User Datagram Protocol is a connectionless transport protocol providing no guaranty of delivery or reliability. GigE Vision Control Protocol and GigE Vision Stream Protocol are based on UDP.

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